No. 12848 2678

United States
Court of Appeals
For the Ninth Circuit.

see vol. 2677

THE PARKER APPLIANCE COMPANY, a Corporation,

Appellant,

vs.

IRVIN W. MASTERS, INC., and JOSEPH C. COLLINS, Doing Business Under the Firm Name and Style of Collins Engineering Company,

Appellee.

Transcript of Record
IN FOUR VOLUMES
Volume III
(Pages 925 to 1322)

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Appeal from the United States District Court, Southern District of California Central Division.

Phillips & Van Orden Co., 870 Brannan Street, San Francisco, Calif.

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[Title of District Court and Cause.]

Civil Action Nos. 7874-B and 8023-W

DEPOSITIONS OF FREDERICK E. AMON, JR., AND ROBERT HENRY DAVIES

taken before William E. Ferris, a Notary Public within and for the County of Cuyahoga, State of Ohio, at the offices of Messrs. Thompson, Hine & Flory, 1122 Guardian Building, Cleveland, Ohio, commencing at 2:00 p.m., Thursday, May 5, 1949, pursuant to the attached notices.

Appearances:

MESSRS. BAIR & FREEMAN,
135 South La Salle Street,
Chicago 3, Illinois, by
MR. WILL FREEMAN and
MR. W. M. VAN SCIVER,
For the Plaintiff.

MESSRS. HUEBNER, BEEHLER, WORREL, HERZIG & CALDWELL,
610 South Broadway,
Los Angeles 14, California, by
MR. VERNON D. BEEHLER,
For the Defendants.

Also Present:

MR. IRVIN W. MASTERS,
President of Defendant Irvin W. Masters, Inc. [2*]

* Page numbering appearing at top of page of original Reporter's Transcript of Record.

May 5, 1949, at 2:00 P.M.

Mr. Freeman: It is stipulated by and between counsel that the record here made shall be usable in both of the above-captioned cases.

I want the record to show that there has been made available to the defendants Joseph C. Collins and Irvin W. Masters, Inc., the drawings, catalogues, and other data requested by Defendant Joseph C. Collins in his motion, and particularly the data referred to in the proceedings before his Honor, Campbell E. Beaumont, on Monday, May 2, 1949. The defendants have requested additional shop drawings for the years 1930 to date with respect to couplings of the sizes 6, 8, and 12, and these drawings are to be made available to the defendants at Plaintiff's plant at the completion of the proceedings here.

Now, that is all correct, isn't it, Mr. Beehler?

Mr. Beehler: Right.

Mr. Freeman: Just off the record a minute.

(Discussion, off the record.)

Mr. Freeman: So that the record is clear, we—that is, The Parker Appliance Company—have complied with your understanding of the [4] proceedings before his Honor, Judge Beaumont, of Monday, May 2nd. That is correct?

Mr. Beehler: That is correct. With the understanding that you are going to help us continue to pick up the additional drawings which we have asked for.

Mr. Freeman: And that, too, is correct.

Mr. Beehler, I understand that you are now here as attorney for Irvin W. Masters, Inc., the defendant, as well as Collins.

Mr. Beehler: That is right.

Mr. Freeman: So that any service of any papers upon you by the plaintiff is service upon both defendants?

Mr. Beehler: Yes. [5]

FREDERICK E. AMON, JR.

of lawful age, called as a witness on behalf of the Plaintiff, as provided by the Rules of Civil Procedure for the District Courts of the United States, being first duly sworn, as hereinafter certified, deposed and said as follows:

Direct Examination

By Mr. Van Sciver:

Q. 1. Please state your full name, age, and residence.

A. Frederick E. Amon, Jr.; age, 39. I live at 766 Quilliams Road, Cleveland Heights, Ohio.

Q. 2. By whom are you at present employed?

A. I am presently employed by The Parker Appliance Company.

Q. 3. What is your position with that company?

A. My position is Manager of Aircraft Sales.

Q. 4. How long have you held that position, Mr. Amon?

A. I have held the position under that title since June of 1946.

(Deposition of Frederick E. Amon, Jr.)

Q. 5. How long have you been employed by The Parker Appliance Company?

A. Since March of 1936.

Q. 6. What were your duties prior to the time that you [6] became Manager of Aircraft Sales with Parker Appliance?

A. I was employed as a Sales Engineer in 1936. For about two years I traveled all over the eastern part of the country as a Sales Engineer contacting our customers, mostly in the general industrial field rather than aircraft at that time. That was people like the machine tool trade, construction equipment, power plant, and refineries. Then in about 1938—perhaps even a little earlier than that—I started contacting the aircraft industry, the United States Army Air Corps at Wright Field, the Bureau of Aeronautics at Washington, and the Navy Aeronautical Laboratories at Philadelphia. In 1938, late, the Aircraft Industry started to get a lot of these foreign airplane orders in preparation for World War II, and I think from that time on I spent practically all of my time on the aircraft phase of the business, clear through until at least after VE Day. With the big upsurge in war orders, our problems of scheduling shipments and handling this influx of orders got to be so great that I spent a good share of my time on that. That would be particularly 1941, late, on through '44, say. 1941 or 1942, I was appointed Sales Manager, and then after VJ Day the company wanted to get back in the industrial market. We expanded our sales division

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and a General Sales Manager was employed, and in June of '46 I was appointed Aircraft Sales Manager and have worked [7] on aircraft ever since exclusively.

Q. 7. During your employment at Parker Appliance Company, have you had any experience with fittings?

A. Yes; a great deal. All of my early experience with Parker as a Sales Engineer had to do very largely with fittings. Now, the fittings business was a much greater total percentage of Parker's total business at that time than any other group.

Q. 8. Briefly, just what are some of the experiences that you have had with fittings during that time up to the present time?

A. Well, I contacted a great many different industries and plants, talking to engineers and purchasing agents to convince them to buy our fittings, and I worked with them as they started to use them and handled service problems, made trial installations, helped set up procedures for proper flaring and installing of fittings. I made recommended fitting layouts, selected bills of material for installation. I also worked very closely with our engineering group at the plant in working out solutions to service problems and design of special parts, new applications as they came along. One of those would be work done in the high-pressure steam power plant field with the new high-pressure generating units in boilers being adopted.

(Deposition of Frederick E. Amon, Jr.)

Q. 9. You say that you have worked on a number of installations [8] in the field?

A. Yes; I have.

Q. 10. You actually know how these fittings are used and the problems involved with them because of that work?

A. Yes; I know a great many of those problems from first-hand experience.

Q. 11. Would you tell us some of the uses for fittings of the type involved in the suit with seamless tubing?

A. Well, there are really a great many uses for flared type fittings of this type. The reason the Parker fitting was so widely adopted was its ability to meet the requirements of high-pressure systems. A brass flared fitting with copper tubing, which was most commonly used for such things as gasoline lines, automobiles, oil burners, low-pressure lubricating systems on machinery, had not been generally used on high-pressure systems. Parker actively went after the business in this high-pressure field. Parker was at least among the very earliest of any manufacturer in this field that applied the flared fitting with steel tubing; that is, seamless steel tubing. It was adopted very rapidly, particularly in the machine tool industry where they were in an expanding program of applying hydraulic principles of operation to all types of machine tools.

Q. 12. You speak about high-pressure installations. What [9] degree of accuracy is required in fittings in high-pressure installations?

(Deposition of Frederick E. Amon, Jr.)

A. Well, in high-pressure installations you require a high performance type fitting.

Q. 13. What is the reason for that, or reasons?

A. Well, the work that's required to be done by the fitting in maintaining a pressure tight mechanical seal on tubing under very high pressures is such that you have to have a fitting that is designed for that purpose, and it has to be made within rather close limits of the dimensions for detailed parts that are specified in order to make the fitting perform up to the requirements. The same is true of materials. A fitting for high-pressure service of any one detailed design, that is, one particular set of detailed matching drawings, might be entirely satisfactory in one material but completely unsatisfactory in a different material.

Q. 14. Is it necessary that fittings in high-pressure systems be absolutely leak proof?

A. The answer is yes. Any leakage is undesirable. It may be of varying degrees of seriousness, depending on the type of system you are talking about.

Q. 15. Well, you mentioned that these fittings were used in aircraft. Could you give us a few examples where in aircraft the flared type fitting is used today? [10]

A. The flared type fitting in aircraft today is used on the fuel lines which carry fuel from the tanks to the engines. It's used on the hydraulic power systems for landing gears, for retracting wing flaps, for operating various devices where

(Deposition of Frederick E. Amon, Jr.)
hydraulic power is used. In military planes it's used on bomb bay doors. It's also used in the instrumentation system on an airplane in connection with flight instruments, most of which will operate on air pressure or vacuum. It's used for hydraulic feathering of propellers. It's used in the de-icing and anti-icing systems other than the thermal type.

Q. 15. Why is it that piping systems where these fittings are used are necessary in aircraft?

A. If I understand the question correctly, you say, why are piping systems necessary in aircraft? Well, without atomic power, so long as we fly airplanes burning gasoline or kerosene or anything similar, we must have piping systems to carry that from the fuel tanks, which store the gasoline in large quantities which are scattered through the airplane in the main body of it or fuselage and out through the wings. Now, that gasoline must be carried to the engines, which may be one or more. The P-36 has six engines, and they are adding four more jet engines.

Q. 16. Because of the fact of remote control in airplanes requiring piping systems? [11]

A. Oh, definitely; yes. That is particularly true with respect to the hydraulic systems. Now, that might be done by other means, although—that is, when I say "other means," there are possibilities of using electric power, but hydraulic power is selected by aircraft designers as a source of power to do much of this work, and a great part of that is remote control. Hydraulic systems are used for

(Deposition of Frederick E. Amon, Jr.)
augmenting manual control, such as in boost systems on the controls for the elevators and ailerons and rudder that direct and guide the airplane.

Q. 17. What are some of the pressures that are used in such hydraulic systems?

A. A common pressure for hydraulic systems on the airplanes being designed and built today is 3,000 pounds per square inch. They are referred to as 3,000 p.s.i. systems.

Q. 18. Is that considered a high-pressure system?

A. Yes; that is a high-pressure system. Not a great number of years ago the pressures were generally in the neighborhood of 1,500 pounds per square inch maximum. In the general use of hydraulic power in fields other than aircraft 3,000 p.s.i. is a high pressure.

Q. 19. Are the requirements for piping systems and these fittings any greater when you go from the lower pressure, say, 1,500 pounds to, say, 3,000 pounds pressure? [12]

A. Well, yes; very definitely. The problems of handling 3,000 pounds pressure compared to 1,500 pounds are much more than twice as severe.

Q. 20. What bearing does that have on the fitting problem?

A. Well, under the requirements of these high-pressure systems, the fittings, along with all other units in the system, have to do a much better job to stand the much greater loads that are put on them, much greater stresses that are put on them.

(Deposition of Frederick E. Amon, Jr.)

Q. 21. When you speak of a 3,000 pound pressure system, is that the peak pressure that exists in that system?

A. No; that is not necessarily the peak pressure. That's referred to as the operating pressure. Peak pressures in hydraulic systems for any given operating pressure may run much higher. All those things are determined by the actual system you are speaking of, but pressures fifty per cent higher as momentary surges or peaks are very common.

Q. 22. Does that give rise to any problems as to the strength of the fittings, vibration problems, or anything of that nature?

A. Yes; it does, particularly in the sense that these surge pressures or peak pressures are applied very suddenly and they are shock pressures. Requirements on [13] fittings to withstand such shock pressures are much greater than a fitting that would just be required to withstand a slow buildup to that pressure and just hold it. It's also very necessary to have a high safety factor on high pressure systems which are subject to surge pressures or shock pressures, when you are talking about systems in which there is a high velocity flow. Speaking in general, when you go to higher pressure systems on airplanes, you automatically get along with it higher velocity of fluid through the lines. The fluid has weight, and sudden stopping of this fluid by the closing of the valve creates a physical impact shock on the system. The fittings and the tubing installation has to withstand these shocks

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without failure. And their effect is not the same actually as just a buildup of pressure inside, it's a ram effect or a hammer effect. You have heard it in your water pipes. Sometimes you close a valve and make it a very loud bang. You can actually feel the pipe jump in your hand. That's the type of effect I am speaking of.

Q. 23. With these high pressures is there any tendency for the pipe itself to whip, like a fire hose?

A. Oh, yes; there certainly is. If the tubing is not properly supported and bends and at rather frequent intervals along its length, and if it is not fully supported at the fitting connections, you do get this whip, [14] which may give the effect of a mechanical vibration. The tubing will actually vibrate so that you can see it. As the fluid passes around a bend in tubing or as it hits an elbow and has to change directions suddenly, the tendency of the fluid passing through there is to straighten out that bend. The higher the velocity flow, which goes along with higher pressures in lines of the same size, the greater that effect is.

Q. 24. Is there any tendency on a piping system where a bend is close to a fitting that the pipe has a tendency to pull out of the fitting?

A. Yes; for the same reason that a flow hitting a valve which suddenly closes tends to make the whole valve move in the same direction that the flow is passing also can be applied to the flow passing through a fitting and then to a bend close to the fitting. The tendency of the flow there is to

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carry the tubing at the bend along with it and move it away from the fitting.

Q. 25. Do any other types of vibrations have to be considered in the design of fittings for this type of operation?

A. Yes; there is the mechanical vibration problem. In aircraft particularly, where every effort is made to keep the weight of the whole plane at a minimum, and where you have engines of a very high horse power rating, compared [15] to the weight of an airplane as against a bus, for example, where you have a big engine but compared to the weight of the bus it's much less, the high horse power of an airplane engine creates a very severe vibration problem in aircraft design and in installation of all kinds of aircraft installations, including fittings and tubing lines. The engines are mounted on flexible engine mounts. If you ever stood at the airport and watched an engine start, where you can see through the cowl ventilators, and actually see the engine cylinder heads, you will see it shake very visibly and over what would appear to be a matter of inches as it is getting started. Then as it levels down into a running speed, you won't see that shake any more, but it does transmit a continuous mechanical tremor through the whole airplane. If you ride in one of these modern airplanes and put your fingernail against a window, you very probably will feel a very definite tremor there all the time.

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Q. 26. Does that problem become more acute with higher horse power engines?

A. Oh, yes; very definitely. And it has become very acute in the jet propelled aircraft. There we are dealing with frequencies of vibration that are much higher than have had to be overcome in the reciprocating engine powered airplane. [16]

Q. 27. What is the effect of these vibrations that you have been talking about in so far as the joint between the tube and the fitting is concerned?

A. The piping lines run through most of the sections of the airplane and they are clamped at various points and attached to end fittings which are attached to units mounted in different basic parts of the airplane. The fact that the whole airplane vibrates means that one part moves with respect to the other and that makes a continuous flexing of the lines and joints. It's particularly bad where you come to the terminus of a line and it's attached to a heavy unit. A heavy unit doesn't just vibrate with the line that's attached to it. Now, this type of vibration, when you consider lines running from an engine to the fire wall behind the engine, can be very severe. At the present time, it's almost impossible to use rigid tubing with flared fittings on that kind of installation, because the vibration is so great. However, not a great number of years ago that was done and a high performance fitting was required. Now, conditions in other parts of the airplane today vibrationwise are almost as bad as

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they were several years ago connecting directly to the engine.

Q. 28. What is the effect of vibration on a tube with an improperly designed fitting?

A. A tubing under vibration tends to work harden, [17] and most materials used in tubing, and the longer the vibration continues the more fatigue is set up in the metal and eventually it will fracture. If you have a poorly designed fitting, it will allow this tubing to fracture at an early time compared with the time it's subjected to this vibration. If you have a high performance fitting, you can expect that it will enable that joint to stand up for hundreds of hours of flying time on an airplane.

Q. 29. What might happen if the tube fractures in, say, a hydraulic system of an airplane?

A. The failure of a tubing line in a hydraulic system on an airplane will result in loss of some, if not all, of the hydraulic fluid in the system. At least the fluid in that part of the system where the failure has occurred will be lost, will run out, and not only will it make it impossible to use the hydraulic units in that system but the oil itself is inflammable and it is a bad fire hazard. Failure of a hydraulic line on a landing gear can cause a belly landing.

Q. 30. What about fracture of a fuel line on an airplane?

A. From a fire hazard standpoint, fracture of a fuel line is even worse than a hydraulic line. Fracture of a fuel line in the engine section of the air-

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plane is an [18] extreme fire hazard. Despite the best fire protection equipment that is available, there are many cases of engine compartment fires. Fracture of a fuel line in any other portion of the airplane, of course, is almost as bad. They have so much electrical equipment and there is a possible source of sparks, of course. You know about the DC-6 trouble that got so much publicity in the paper where fuel got in the wrong place in an airplane; not due to the fracture of a line but got near a heating unit and caused very serious fires.

Q. 31. Is it true that fractures of the type you have mentioned might cause loss of life and loss of the plane?

A. Oh, very definitely. It has caused many crashes during the period since the airplane has first been commonly used.

Q. 32. You mentioned the use of these fittings on high-pressure systems. Are the same type fittings used on lines where sub-atmospheric pressures exist at times?

A. Yes. There are a number of requirements in a modern airplane for use of vacuum. The fitting, in order to be an acceptable fitting, has to be suitable both with pressure and with vacuum.

Q. 33. So that you have to have a fitting that is suitable for lines carrying below atmospheric pressures up to 50 per cent above 3,000 pounds; is that correct? [19] A. That is correct.

Q. 34. And it's the same fitting that does both jobs in some cases? A. That is correct.

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Q. 35. You have mentioned the dangers of fractures of lines. What about just leaks from lines carrying hydraulic fluid or fuel; is there any danger there?

A. Yes; any leak is dangerous. In a hydraulic system, even though leakage may never accumulate any place where it can cause a fire, a slow leak may make the system inoperable without giving the crew the warning that they might get with a bad leak. In fuel, a slow leak, of course, is very bad, because no matter what you do with the gasoline it must be regarded as a hazard. A slow leak is generally a sign that you will have a bad leak before very long at that point.

Q. 36. Do you take into consideration in the Parker flared fittings these problems relating to vibrations? A. Yes.

Q. 37. Problems relating to the prevention of leaks?

A. Yes. The type of installation that Parker has always tried to get for their fittings have been the installations that require high performance fittings, and it's those very problems that we dealt with week after week, year after year. That was the whole central point, central [20] focus, on fitting design, a higher performance fitting.

Q. 38. Are your fittings designed to take care of the pressure range below atmospheric to perhaps 4,500 pounds?

A. When Parker first started to sell fittings and manufacture fittings for the high-pressure field, we

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didn't think so much of 3,000 pounds. We have always thought of vacuum lines, but in the 20 or 25 years since this has gone on, the fittings have been improved as these higher operating pressures and worse vibration conditions came into being to keep in step with the requirements.

Q. 39. As those problems developed, did Parker Appliance Company meet those problems with their fittings?

A. Yes; it's my honest opinion that they did. I can't say that they always got it the first time they tried. There have been long series of tests and try-outs on improvements, and even construction of special design, many of which turned out eventually not to be too good. It's all been a matter of continuous development of a tube fitting to meet these more difficult installation requirement as they were presented to us.

Q. 40. Do you happen to have any degree in engineering, Mr. Amon?

A. Yes; I am a graduate of the Rensselaer Polytechnique Institute and I have the degree of E. E. That's Electrical Engineer. [21]

Q. 41. Are the Army and Navy interested in the development of fittings for their aircraft?

A. Is the question, are they interested or were they interested?

Q. 42. Well, were they?

A. Oh, yes; they were interested by necessity. The requirements on fittings were so important in connection with the functioning of airplanes that

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they could not have possibly overlooked it even if they wanted. They have been very interested in it for many years.

Q. 43. What have you done in that connection personally?

A. Speaking of the airplane industry and the Army and the Navy, I started working with the United States Army Air Corps in the engineering laboratories, and with the Navy Department through the Bureau of Aeronautics in their laboratories at Philadelphia about 1948. I made regular contacts, which I remember being at least once a month, with personnel in those organizations. During such contacts, there was much discussion of fittings and fittings problems and service reports and new requirements to be anticipated, use of tools for flaring tubing to be used with fittings, and improvements in those tools.

Q. 44. Are you familiar with the fitting known as the type AC 811? A. Yes. [22]

Q. 45. Are you familiar with the type of flared fitting known as the AN fitting? A. Yes.

Q. 46. Did you work with the Army and Navy on both of those types? A. Yes; I did.

Q. 47. Just what did you do in connection with the two types of fittings?

A. The Army Air Corps, which preceded the present United States Air Force organization, was already using the AC 811 fitting as a standard when I first started to contact them. For several years, my work with them on the 811 fitting was centered

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around improvements and tests being run and application of the fittings to new requirements coming up. The Navy at that time was in a transition on fittings and were using some of the AC 811 fittings, some of those that preceded the AC 811 as an Air Corps standard——

Q. 48. May I interrupt? Just what period of time are you speaking of now?

A. I am speaking of the period of a year to two years, or, say, 1938 and into 1939 at this point. In 1939, I first started to work on the standardization problem on fittings.

Q. 49. Let me interrupt again. Do I understand the AC 811 preceded the AN fitting? [23]

A. Yes; the AC 811 fitting preceded the AN fitting.

Q. 50. Proceed.

A. From 1939 through well into 1941, a great share of the work that I did with the military services on fittings was in connection with this AN Standard which was being worked out at that time. We made—that is, the Parker Company made recommendations of various things to be used in a standard fitting, and I did liaison work between our engineering department and the engineers of the services on various technical matters in connection with the AN standardization program on fittings.

Q. 51. And that was late in 1939 and early in 1940?

A. That started early in 1939 or even in 1938.

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That's pretty far back to remember exactly, but I can sort of date it by when I got married, which was in 1939. The standardization work didn't start directly on fittings as a formal standardization program. It started first on screw threads.

Q. 52. Tell us just what transpired, to your personal knowledge, on the change-over from the AC 811 to the AN flared type fitting.

A. When you ask that question, do you mean the change-over as a standard or the change-over in the sense of change in the use of the fittings?

Q. 53. Well, let me ask you this: Was the AC 811 a [24] standard type fitting with the Army?

A. Yes; the AC 811 was the standard fitting used by the Army Air Corps.

Q. 54. Did they issue a standard drawing on that fitting?

A. Yes; they had a standard drawing in the Air Corps Standards Book.

Q. 55. Does "AC" stand for Air Corps?

A. Yes. I don't believe I have to qualify that. I can't say that that is the actual official designation, but everybody in the industry has always referred to it that way. It was an Air Corps Standards Book.

Q. 56. Now, tell us what happened in the transition from the time that the AC 811 was a standard to the time that the AN flared fitting became a standard, that you had personally to do with.

A. The AC 811 was formally made a standard in 1935, and it continued as the standard of the Air

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Corps until it was superseded by the approved release of the new AN standard, which was at the very end of 1940 or very early in 1941. The transition in use didn't take effect until after that date and extended over a period of a number of years. At the time the new standard was introduced, we were in almost peak war production and the airplanes we built were in all cases airplanes that had been designed [25] and first built with the AC 811 fittings, and so those were the fittings that were ordered to meet the production schedules, and the AN fitting was introduced on experimental airplanes and worked its way into production airplane contracts that followed from such experimental airplanes, and as the new airplanes replaced the pre-war airplanes, the usage and manufacture of the AN fitting crept up and finally passed the usage of the 811. Many of the airplanes in production during the war were changed in the middle of the program by orders from the services. Many of them, however, were not changed even as long as the airplanes were built.

Q. 57. But there was a substantial change-over at that time to the AN flared fitting; is that correct?

A. Yes; that is correct. By 1944, for practical purposes, we could almost say that the change-over was complete. We still sell AC 811 fittings as service parts. For example, on many of the DC-4's now operated by the air lines.

Q. 58. Is it correct that the new planes and prac-

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tically all of the present planes being manufactured for the Army and Navy, as well as private industry, use the AN flared type fitting?

A. Yes; that is quite correct with respect to military airplanes and also large commercial airplanes. [26] With respect to private airplanes, many models are not built with the AN fitting. The better class of private planes, such as the 4-passenger ships, including the Beech Bonanza, use the AN fitting.

Q. 59. I hand you a fitting, which we will mark "Amon Deposition Physical Exhibit 1."

(Fitting marked "Amon Deposition Physical Exhibit 1.")

Q. 59. (Continuing): What type of fitting is that?

A. This is an aluminum alloy AN flared fitting.

Q. 60. What size, do you know?

A. That is a Size 8.

Q. 61. Is that a Parker flared fitting?

A. Yes; it has the Parker symbol on the metal.

Q. 62. You say that is an AN fitting. I note there is a part cut away there. What is the purpose of that?

A. The purpose is obviously to show the internal construction. This fitting has a tube in it. It's been assembled and then cut away to show the makeup of the coupling to make a pressure-tight seal.

Q. 63. So Exhibit 1 is an AN fitting with a portion cut away to exemplify the construction; is that correct? A. That is correct.

(Deposition of Frederick E. Amon, Jr.)

Mr. Van Sciver: I offer this in evidence as Amon Deposition Exhibit 1. [27]

Mr. Beehler: May I see it?

Mr. Freeman: Off the record.

(Discussion, off the record.)

Q. 64. Does the Parker Appliance Company sell fittings of the type exemplified in Exhibit 1 to others besides the Army and Navy?

A. Yes. Particularly we sell them to companies who build airplanes, commonly known as airplane manufacturers, and to companies building aircraft engines.

Q. 65. Could you give us the names of a few of those companies that Parker sells to?

A. Yes. Boeing Airplane Company, Douglas Aircraft Company, Lockheed, North American, Consolidated Vultee, McDonald Aircraft, Drummond Aircraft, Republic Aviation, the Glenn L. Martin Company, Fairchild, General Electric.

Q. 66. Do you know what General Electric used the flared fittings for?

A. Yes; the General Electric Company is purchasing them today for use on the TG-190 jet engine, which is in production.

Q. 67. That is for jet propelled airplanes?

A. Yes; that is correct.

Q. 68. You mentioned a number of applications for flared fittings in seamless tubing. What types of piping were in general use for some of these

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installations prior to the [28] use of the seamless tubing with flared fittings?

A. In general, pipe was used, iron pipe, or perhaps pipe with tapered pipe threaded connections. For smaller lines, in airplanes, they used seamless copper tubing but with a non-flared fitting. It was a fitting in which one of the fitting parts was soldered to make a bond with the end of the tubing so that it could be in turn clamped against a fitting to make a joint.

Q. 69. Does the flared type fitting have any advantage over the soldered type fitting that you just mentioned for aircraft?

A. Yes; it has a number of advantages.

Q. 70. Will you state what they are?

A. Copper tubing, which is ideally suited for use with any soldered or brazed connection, has two undesirable characteristics on aircraft: One is its poor weight-strength ratio compared to aluminum tubing, for example; the other is that it has work hardening characteristics, which mean that it would fracture under vibration more quickly than many other alloys, metal alloys that can be used in tubing but which may not be suited for soldering.

Q. 71. You mentioned that iron pipe had been used in some installations, too. Do flared fittings and seamless tubing have any advantages over iron pipe? A. Yes; many advantages. [29]

Q. 72. Will you state what they are?

A. These advantages have been so widely recognized that the flared fitting with a relatively thin walled seamless tube was adopted in use so widely

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for hydraulic systems in the industrial field. In using pipe at the operating pressures required, they in most cases used extra heavy or double extra heavy pipe, which means pipe of a much heavier wall thickness to withstand the internal pressures. Going to an extra heavy pipe of any one nominal size, such as a ¾ inch pipe, gives you a smaller hole through the center than you have on standard pipe, and if you want a big inside hole to get the required flow through the lines, you have to go through a bigger sized pipe, which means bigger fittings, and they take more room. The pipe fittings, whether they are standard weight or double extra heavy weight, are all assembled by cutting threads on the end of the pipe and screwing it into a fitting. These threads are exposed at the fitting and are the weakest point where the line may be expected to fail. In other words, you use a heavy pipe to get high strength and then you cut these threads right in the wall of the pipe, which means you might as well have used a thin pipe with a heavy section on the end.

Q. 73. And fracture is more likely to occur at that point than other places in the pipe? [30]

A. That is correct. When you use pipe, in order to disassemble it and get it off a piece of equipment so that you can service valves or replace valve seats or take off hydraulic cylinders to replace packings, you have to disassemble in many cases quite a section of piping because you have to go some place where there is a union provided in a line in order

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to break it. With flared fittings and a seamless tubing, you can use a much thinner wall in the first place for the same strength, because you do not cut any threads on the outside of the tube. This means that you can use smaller size lines and fittings for the same flow capacity.

Q. 74. Does that reduce the weight for the same flow capacity also?

A. Yes; it reduces the weight very appreciably and it reduces the amount of room required to get the lines installed and in place. You can put a number of small lines in a small place, cramped quarters where there isn't much room to get them, if you use small lines, whereas with pipe you would have to go through great complications to get them all in there.

Q. 75. Is the weight factor and the factor of being able to assemble and disassemble in cramped space of any particular importance in the aircraft industry?

A. It's of vital importance in the aircraft industry [31] in both cases; that is, for weight reduction and for ease of assembly and disassembly and the ability to get more lines in a small space. Airplanes are designed to carry a certain pay load or accomplish a certain mission. The less weight of airplane you can have for the required pay load the more efficient the whole airplane will be. That permits the use of smaller engines for the same speed and permits advantages of all kinds. It's the thing towards which all aircraft design is really directed.

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In the military picture we also have high speed in combination with low weight as a design requirement, and operations at high speed bring in additional strength requirements which make it even more necessary to keep the weight at a minimum where it is permissible to do it and still have units that will function properly.

Q. 76. What about the facility of the assembly and disassembly in cramped spaces?

A. In order to get all of the things in an airplane that have to go in it, you need a body or a fuselage. That has to be streamlined to keep down wind resistance. In striving for the idea combination of strength and weight-carrying capacity and streamlining, you run into almost unbelievable ways of putting things inside the shell of the airplane.

Q. 77. As a matter of fact, they used some pigmies during [32] the war, didn't they, to assemble some parts in airplanes?

A. Yes; that is right.

Q. 78. Go ahead.

A. With this high premium on space, it's vitally important that units of all types, and particularly these fittings and tubing lines of which there are a multiplicity, be put into the smallest possible space. That means that they are then very close together and they are very hard to get at when you assemble them and tighten the joints and hard to get at when you disassemble them to remove units for repair.

Q. 79. Does the Parker flared fitting permit the

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assembly and disassembly in these cramped spaces?

A. Yes; the Parker flared fitting is one of the best designs to accomplish this purpose.

Q. 80. What is that?

A. Starting with the fact that on tubing systems installed with flared fittings every joint may be regarded as a union where the line can be disconnected, the Parker fitting permits the line to be removed——

Q. 81. You are talking about the type that you have there in your hand, Amon Deposition Exhibit 1?

A. Yes. (Continuing)—— permits the line to be removed with the minimum amount of juggling or interference with other lines or other parts of the airplane after the [33] joint is disconnected. When the nut is unthreaded from the body, it can be slipped back conveniently out of the way, even though the fitting may be immediately adjacent to a close bend, and then by separating the fitting from the body, that is, separating the tubing from the body, only a very short distance, as represented by the depth of the flare, you can slip it to one side and pull the line free.

Q. 82. What would happen if the sleeve and the nut jammed in a fitting?

A. If the sleeve and the nut jammed, it might be difficult to move the nut back along the tube to permit removing the tube without interfering with other parts. This is particularly true if there is a bend close by which would prevent the sleeve from

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passing around the bend, although permitting the nut to pass around. Many lines are installed with identification markings around the tube to show what kind of fluid is in the line, and that would interfere with the sleeve sliding back to get out of the way so that you could slip the tube free.

Q. 83. Is there anything in the construction of the fitting that you have in your hand that will prevent the nut and sleeve from jamming, and, if so, what is it?

A. This fitting which I am looking at, Exhibit 1, incorporates a feature that was introduced into these [34] fittings by Parker specifically to assist in that problem. There are other advantages at the same time, but with the higher wrench torques that were required at the operating pressures of hydraulic systems, as well as other systems, went up, it meant that there was more likelihood of the fitting being distorted sufficiently to lock the sleeve and nut together, and this fitting includes a relief or an angle on the outside of the head of the sleeve here which enables the nut to remain free of the sleeve when it's loosened from the body of the fitting so that it can be moved out of the way.

(Recess.)

Q. 84. What comparison is there in pressure drop in iron pipe or in seamless tubing with flared couplings?

A. There is a very wide difference in favor of much lower pressure drop through seamless tubing and flared couplings. Seamless tubing is smoother

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inside than the pipe, which provides lower pressure drop through the whole system. When flared fittings are used with seamless tubing, the number of fittings are kept at a minimum by using bends in the tube wherever possible instead of adding extra fittings, such as elbows, to make these bends. Elimination of any bend reduces pressure drop, and the substitution of a smooth sweeping bend for a sharp right angle bend also reduces pressure drop, and the fitting used with [35] threaded pipe, as an elbow, has a non-uniform section through it in terms of differences in area, which also increases the pressure drop. The center portion of the fitting where it is machined out to receive the threaded-in pipes at each end is larger and results in increased turbulence of the flow as it passes through.

Q. 85. Are there any advantages in general installations with respect to decreasing the pressure drop?

A. In hydraulic systems we are striving to push oil through a piping system from a pump to some other mechanism where it will do some good, and the quantity of oil required is important and the pressure at which it reaches the unit where it is to do the work is important. Greater quantity gives faster speed and higher pressure means more work with a smaller unit, such as a hydraulic cylinder or a hydraulic lift. Higher pressures mean more work can be done with a smaller work-producing unit.

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Q. 86. Is that true in any fluid-carrying system where you are forcing fluid through a line? In other words, is your answer limited to a hydraulic system?

A. No; it's not limited to a hydraulic system, although I mentioned in hydraulic systems we are trying to do work. Many fluid systems are not for the purpose of doing work but moving the fluid. They want to get the fluid from one place to another. That would be typical of a [36] gasoline piping in an airplane. You have to get the gasoline from the tanks up to the engine and then it burns in the engine. That's where the work is done. But you have to pump it through the piping from the tanks to the engine, and with a minimum of pressure drop in the system you require less work done at the pump, meaning smaller pumps and lighter pumps and less consumption of power in order to get the required quantity of fuel to the engine.

Q. 87. So that generally you get the fluid where you want it with less work; is that correct?

A. Yes; that is correct.

Q. 88. In aircraft, is it particularly important that any particular phase of aircraft have a low pressure drop in your lines?

A. Yes; it's particularly important from the weight standpoint. To handle the same amount of fluid through a smaller line with the same amount of pressure reduces the weight of the lines and the fittings.

Q. 89. How about in vacuum fuel lines?

A. In vacuum fuel systems and suction type

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fuel systems another reason for low pressure drop becomes very apparent and that is in precluding vapor lock.

Q. 90. What is vapor lock? What does that term mean?

A. Gasoline includes air. Air dissolves in gasoline. As long as you keep some pressure on the fuel, you will have [37] some air in there, but it won't hurt anything. If you suddenly release the pressure from the fuel, the air will come out, it will boil. In an airplane fuel tank, as the plane takes off from the ground and goes rapidly to a high altitude where the atmospheric pressure falls off to a portion of what it was at sea level, there is a vaporation and loss of air from the fuel into the tank. As gasoline is passing through a fuel system of the suction type, you have a limited amount of pressure available at the tank end to make the fuel pull through. Now, that is the atmospheric pressure. Unless we are speaking of pressurized tanks, which we won't speak of here for the moment. You may have booster pumps in many airplane fuel tanks, but that is not what I am speaking of as a suction fuel system. In a suction fuel system you have a pump on the engine which forces fuel through the engine and under pressure, but the pump has to be kept filled and a suction is created at the pump inlet. The only thing that makes the fuel flow into the pump is that this suction at the fuel pump inlet will be less than the pressure tending to make the fuel flow through the line. With limited pres-

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sure at the source as in the tank, with too much pressure drop, the fuel will not go through the line fast enough to keep the pump full and you get formation of a vapor there as you would in the tank itself as the airplane [38] goes up to a lower pressure. That causes malfunctioning of the pump in the sense that it will not maintain a continuous flow of fuel to the engine, and the engine may even clunk out, as it's spoken of. Even with booster pumps or with pressurized tanks, if you have electrical failures, you may have to operate under emergency conditions, wherein you only have the engine pumps to supply fuel, and there this vapor lock becomes a serious problem. It's particularly bad at high altitudes.

Q. 91. I believe you mentioned that the Parker flared fitting that is exemplified in Exhibit 1 could be assembled and dissassembled in small, cramped spaces. May that type of fitting be assembled and disassembled a number of times? A. Yes.

Q. 92. Is there anything in the construction of the fitting, Exhibit 1, that affords that assembly and disassembly repeatedly?

A. Yes; there is.

Q. 93. What is that feature?

A. There are several things which are important in a fitting which is to be assembled and disassembled a number of times. First, the fitting parts should not be damaged when they are assembled, and neither should the tube be damaged. The construction of this fitting is such that when the nut is threaded onto the body, the tubing is [39] clamped

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between the sleeve and the body nose, but without any wiping or sliding contact between any portion of the fitting or its parts and the tubing. This means that there is a minimum of wear on the flare, and that in itself allows it to be assembled more frequently than a fitting where there is wear or damage to the flare.

Q. 94. What do you mean by wiping or sliding contact on the tube?

A. If the sleeve or any portion of the fitting after it's in contact with any portion of the flare tends to turn while it's in contact and under pressure, it rubs hard on the surface of that flare and tends to grind off the metal or roughen the metal. That can actually grind away metal or it can roughen the surfaces to the point where they would create leaks on re-assembly. On fittings used with aluminum alloy tubing, the wiping contact may be particularly bad because of the strong tendency of aluminum alloy parts to gall or actually lock themselves together under rubbing contact. I have seen examples of such galling where, when the parts are removed, some of the original metal of one part actually has stuck to the other part so hard that it pulled itself completely away from its body and came out with the mating part.

Q. 95. Proceed with your answer with respect to the constructional features of the fitting, Exhibit 1, that [40] permit repeated assembly and disassembly.

A. Will you repeat that question, please?

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Mr. Van Sciver: Will you read it back, please?

(Question read.)

A. I mentioned that to permit assembly and disassembly a number of times and still be satisfactory for use the fitting parts must not be damaged. The design of this fitting here in Exhibit 1 has a feature that prevents a locking of the sleeve inside the nut by limiting the distortion of the sleeve portion during assembly so that it does not assume any permanent distortion.

Q. 96. And what is that construction?

A. The portion of this sleeve that is subject to stress on tightening is the head end or the part adjacent to the flare. As a coupling is assembled tight, the nut pulls against the—that is, the shoulder on the nut pulls against the mating shoulder on the sleeve tending to drive it down against the flare harder, and this in turn, since the flare is at an angle, expands the end of the sleeve.

Q 97. What permits that expansion?

A. The question is, "What permits that expansion?" A clearance is provided between the toe of the sleeve and the inside portion of the nut which is opposite it so that it can expand as the fitting is tightened, but still cannot [41] expand beyond a limited amount without coming in contact with the nut, at which point further expansion would be stopped.

Q. 98. What permits that? What causes that clearance that you just mentioned?

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A. Well, the clearance is caused by a difference in angular relationship between the inside surface of the nut and the outside surface of the sleeve where the two are opposite each other. The inside surface of the nut there is parellel to the center line of the tube, whereas the outside surface of the sleeve tapers.

Q. 99. Is that the construction that you mentioned which would permit or assist in assembly and disassembly?

A. Yes; that is correct.

Q. 100. And without a jamming of the nut and sleeve together, locking?

A. Yes; that is right.

Q. 101. I hand you a drawing, which we will mark for identification as "Amon Deposition Exhibit 2."

(Drawing marked, "Amon Deposition Exhibit 2.")

Q. 101. (Continuing): Would you mark on that drawing the angle on the sleeve that you were just talking about? First, mark the sleeve itself and note it as "sleeve." Then mark the nut and the body. Now, will you put the word "tube" on the tube? And will you mark the flare on the [42] tube?

A. (Witness does as requested.)

Q. 102. Do you know what the actual angle is on the outside of the sleeve in Exhibit 2?

A. The angle on the outside of the sleeve is one or one and one-half degrees.

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Q. 103. What do you call that angle?

A. I call it the sleeve head angle.

Q. 104. All right, will you mark that as the sleeve head angle?

A. (Witness does as requested.)

Q. 105. Will you mark the shoulder of the nut that contacts the sleeve; that is, the shoulder which is perpendicular to the axis of the tube?

A. You mean, the shoulder on the nut which engages the sleeve to pull it against the flare?

Q. 106. Correct.

A. I will mark that "nut shoulder."

Q. 107. And then will you mark the shoulder of the sleeve that the nut shoulder contacts?

A. (Witness does as requested.)

Q. 108. Is that drawing, Exhibit 2, an exemplification of the fitting, Exhibit 1, as far as parts are concerned?

A. Yes. It is not necessarily the same sized fitting. This is an enlarged drawing. [43]

Q. 109. Do you know what size fitting the drawing Exhibit 2 was made from?

A. I can't say from looking at this Exhibit 2 only what size it is. From the portions of the tube wall thickness here compared to the tube O. D. it should be a Size 4 or Size 5.

Q. 110. Does the drawing exemplify the Parker AN flared type fitting? At least one type and one size of it?

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A. Yes; this drawing could be any size of the Parker type AN flared fitting.

Q. 111. And does it exemplify Deposition Exhibit 1? A. Yes; it does.

Q. 112. Will you describe specifically the three main parts shown in Deposition Exhibit 2 and state the general function of each of those parts?

A. The three parts of this fitting shown in Exhibit 2 are the body, the nut, and the sleeve. The function of these three parts working together is to engage the end of the tube, which is also shown on the exhibit, to make a pressure tight connection. The tube is flared out at the end in a bell shape with straight rather than curved sections on the inside and outside of the flare, and this flare on the tube rests against the mating cone-shaped nose on the fitting body. The sleeve slides forward on the outside of the tube and contacts the outside of the flare [44] opposite the point where it's supported on the inside by the body nose or cone. At this point the sleeve has a chamfer or conical recess that is approximately a matching to the outside angle of the flare. The sleeve at a slight distance back from the part where it contacts the flare has a narrow shoulder at right angles to the center line of the tube, and this shoulder is engaged by a mating shoulder on the nut in such a manner that when the nut is pulled forward over the shank or narrow diameter of the sleeve it engages the sleeve shoulder and tends to pull it down on the flare. When the nut is threaded onto the screw threads on the body,

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tightening of the nut squeezes the flare between the end of the sleeve had and the cone on the end of the body.

Q. 113. Do you know what the angles of the flared end of the tube are?

A. The flare on the tube is made under a specification covering those angles. The actual angles on the flare may vary slightly, depending upon the method used to make the flare, but if the flaring tools are so designed that they would give a flare that will fall within the specification, the angles on the flare will be approximately 37 degrees on the inside and 33 degrees on the outside.

Q. 114. What brings about the difference in the angles of the flare? [45]

A. When you flare the end of the tube, you stretch the metal at the end of the flare. If the tube had a given thickness before the flaring operation, it will have a lesser thickness at the end of the flare after you spread it to what corresponds to a larger diameter. The metal stretches uniformly around, and although the total amount of the metal in the tube is the same, it's been spread out to a larger diameter.

Q. 115. Do you know what the angle is on the inside surface of the sleeve head; that is, the one that contacts the outside of the flare?

A. That angle is approximately 33 degrees.

Q. 116. Is there any particular name given to that angle on the sleeve?

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A. I know of no particular name other than sleeve angle.

Q. 117. Will you mark that on the drawing?

A. (Witness does as requested.)

Q. 118. Is the testimony which you have given with respect to iron pipe generally true also with respect to threaded brass pipe?

A. Yes; that is true, with the possible exception that brass pipe is much smoother on the inside and outside diameters than standard iron pipe.

Q. 119. You spoke of these high-pressure installations, [46] both on aircraft and in other places, but primarily on aircraft, would lead pipe be suitable for such installations?

A. I can't imagine using lead pipe on any installation in an airplane, particularly in the hydraulic systems and the fuel systems, or even on low-pressure vacuum systems.

Q. 120. Why would lead pipe be unsuitable?

A. Well, its strength to hold pressure is very low compared to even aluminum tubing. To use it on pressure lines would require a very thick walled lead pipe. It's weight would be very high.

Q. 121. Do you know if flared fittings could be used for connecting lead pipe?

A. Yes; flared fittings can be used on lead pipe.

Q. 122. Would the problem be any different with flared fittings for connecting the type of tubing we are talking about, aluminum alloy, steel tubing for hydraulic systems, fuel lines, and the like?

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A. Oh, I'd say they are very different. I can't visualize lead pipe being used on any but low-pressure lines, very low pressure, and only where a minimum amount of pressure seal in the joint would be required. You wouldn't be able to put very much gripping pressure on a lead pipe without squashing the metal away from the gripping surface, unless you have a very wide contact area of gripping surface, [47] which in turn normally means a larger fitting or a longer fitting.

Q. 123. Does the lead pipe tend to flow at the flare when it is clamped?

A. Yes; under pressure other than very light pressure it would be squeezed out from between the clamping surfaces again, unless you have a very wide clamping area which permits a fairly high total clamping pressure, but the unit pressure on the metal can be made very low by spreading it over a very large area of metal.

Q. 124. If the fitting itself or the pipe had eccentricities or was not made to precision specifications, would the lead flowing, as you have just described, take care of those eccentricities?

A. It would under any of the standard pressure flared type fittings that I can recall. If you compare it with a rigid type, such as steel, which is very difficult to distort or move to fit in with eccentricities or imperfections on seats or the like, the lead pipe would relatively very easily be moved to conform to iregularities or ecentricities in fitting because it's so soft.

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Q. 125. Then there are objections to the use of flared fittings on lead pipe; is that correct?

A. Oh, yes; many objections.

Q. 126. Particularly on aircraft fittings? [48]

A. Yes. If I were to use any lead pipe on an airplane for any special purpose that might require it compared to some other pipe, I don't believe I would ever use a flared fitting.

Q. 127. What is the type of flared fitting which is sold by Parker to the aircraft industry at the present time? What do you call it?

A. The flared fitting sold by Parker to the aircraft industry at the present time is called an AN flared fitting or a Parker 3-piece AN fitting.

Q. 128. This AN fitting, that is a Government Standard fitting, I believe you testified to that before?

A. Yes; the AN fitting has been standardized on by the Air Force and the Navy as a joint standard for fluid connections.

Q. 129. Was it the Parker fitting that became known as the AN Standard?

A. These fittings are commonly known through the aircraft industry and even among personnel in the services as a Parker type fitting.

Q. 130. Is this fitting, Amon Deposition Exhibit 1, a Parker AN flared fitting? A. Yes.

Q. 131. Did you have anything to do personally with the development and adoption of the AN fitting by the Army and Navy? [49]

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A. Yes; the standardization on fittings was handled through the Aeronautical Board as a means of bringing together the Air Force and the Navy on requirements for the fitting and reaching an agreement, and the final standard was put out by the Aeronautical Board. During a period which covered almost two years just preceding the approval of this standard, there was a considerable amount of engineering contact and some investigation, and various design features and detailed dimensions to be selected for incorporation in this standard had to be reviewed and approved, and during that period I had a great deal of contact with representatives of the Aeronautical Board and with personnel in the Air Corps and the Navy in their standards groups and in their laboratories who were also interested in this problem. I made a number of different recommendations at various times of details to be considered in this AN Standard. I visited these people and brought back to our engineers information on the requirements they wanted to put in, and assisted in working out suggestions for accomplishing those, with consideration given to manufacturing procedures and methods and also performance requirements. When the AN fitting standardization program had reached the point that assignments had been made for the actual preparation of engineering drawings, the flared fittings [50] which were to be included in the general AN Standard, fittings of various types were delegated to the Air Corps at Wright Field for

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preparation, and I was in frequent contact with the Specification Standards Unit where this work was being done and presented recommendations on a number of phases of the detail work.

Q. 132. Do you know if the sleeve head angle that you have marked on Deposition Exhibit 2 was at any time in the AC811 fitting?

A. Yes; it was.

Q. 133. Was that done at the suggestion of Parker? A. Yes; it was.

Q. 134. And did you ever suggest that that same angle or that a sleeve head angle be placed in the AN fitting?

A. Yes; based on the improved performance that we had found in laboratory tests and the fact that the Air Force appeared to be getting better service on the 811 fittings that included this sleeve head angle, I did recommend to a group at Wright Field who were preparing these drawings that that sleeve head angle be included in the AN Standard.

Q. 135. Did you write a letter to Wright Field to that effect? A. Yes.

Q. 136. And did they actually include the sleeve head [51] angle on the AN Standard?

A. Yes; they did. When the drawings approved drawing, were first released, they included this sleeve head angle.

Q. 137. Is this a copy of the letter that you wrote to Wright Field, which is dated October 25, 1940?

A. Yes; this is the letter in which the recom-

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mendation that the sleeve head angle be included was formally presented. I wrote this letter.

Q. 138. You recollect that independently of the letter?

A. Yes; I remember a great many details of this whole standardization program independently of any letters.

Q. 139. Where did this letter come from, the copy marked "Copy" that you have in your hand?

A. This is from the company files at our Cleveland plant.

Mr. Van Sciver: I offer this letter, dated October 25, 1940, addressed to Assistant Chief, Materiel Division, Wright Field, Dayton, Ohio, Re Proposed Army-Navy Standard fitting, comprising five pages, and signed "The Parker Appliance Company, A. L. Parker, by" the initials F.E.A.:L.E.S. The letter is addressed to the attention of Captain R. C. Brownfield, Specifications Branch. I offer this in evidence as Amon Deposition [52] Exhibit 3.

(Letter dated October 25, 1940, from The Parker Appliance Company to Captain R. C. Brownfield, marked, "Amon Deposition Exhibit 3.")

Mr. Freeman: Has 2 been offered?

Mr. Beehler: I think so.

Mr. Freeman: By agreement of counsel, let the record show that the drawing referred to by the witness Amon has been offered in evidence as Amon Deposition Exhibit 2.

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Q. 140. Does the Government put out drawings, AN Standard drawings, with respect to the AN flared fitting?

A. Yes; there are a series of such drawings covering the fittings that are included under the standard.

Q. 141. Does the Government likewise put out procurement specifications with respect to AN flared fittings?

A. Yes; there is a procurement specification that is shown on each of the AN Standard fitting drawings.

Q. 142. Is that AN-F-366?

A. Yes; that is AN-F-366.

Q. 143. Does the Government put out a standard test method for fittings?

A. Yes; that is AN-F-47.

Q. 144. I hand you a group of Army-Navy Aeronautical Standard drawings, as follows: AN-811, AN819, AND10102, [53] AND10104, AND-10105, AND10106, AND10108, AND10056, AND-10057, AND10059, Sheet 1, AND10059, Sheet 2, AND10061, AND10064, and AND10078. Are all those drawings that I have just handed you drawings which are put out by the United States Government relating to tubing and flared fittings?

A. Yes; that is correct.

Mr. Freeman: We offer in evidence the group of drawings just referred to collectively as Amon Deposition Exhibit 4. Copies of the drawings have been furnished counsel for Defendants.

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(Group of drawings marked, "Amon Deposition Exhibit 4.")

Q. 145. I hand you a pamphlet marked "AN-F-366. Army-Navy Aeronautical Specification fittings, fluid connection." Is that the procurement specification which you just mentioned which was issued by the Govenment covering AN flared fittings? A. That is correct.

Mr. Van Sciver: I offer that in evidence as Amon Deposition Exhibit 5.

Mr. Beehler: I have no objection to the offer of Exhibit No. 5.

(Procurement specification pamphlet marked, "Amon Deposition Exhibit 5.") [54]

Q. 146. I hand you a pamphlet entitled "AN-F-47. Army-Navy Aeronautical Specification fittings, method of testing tube," marked for identification as "Amon Deposition Exhibit 6." Is that the test and specification that you referred to in your testimony issued by the Government?

A. This is the test specification for these fittings. I didn't recall referring to it before.

Q. 147. That is the Government specification for tests on fittings; correct? A. That is right.

Mr. Van Sciver: I offer that in evidence as Amon Deposition Exhibit 6.

Mr. Beehler: No objection.

(Test specification pamphlet marked, "Amon Deposition Exhibit 6.")

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Q. 148. Referring again to Deposition Exhibit 2, the drawing of the Parker type flared fitting, is there any weight-strength advantage in the flared fitting with an outside or a sleeve head angle as shown in that exhibit?

A. Yes; there is. The portion of this fitting which is subject to the most stress under proper assembly tightening is the sleeve head. It's desirable to keep the size of the total fitting at a minimum for weight, irrespective of any material it may be made of. Holding the total fitting to a minimum size requires that a sleeve of a [55] minimum thickness be used, and since the sleeve is a separate portion from the remainder of the fitting, it can be made of a higher strength material than the balance of the fitting, providing greater strength with greater weight only in that part on which the material is changed, which is the sleeve.

Q. 149. Would that be true if the fitting became a two-piece fitting in effect by locking of the nut and sleeve?

A. If the fitting should become a two-piece fitting in effect, as you say, by locking of the nut and sleeve, it has also been stressed sufficiently that the sleeve head has been permanently deformed, and at that point there would be no particular difference with respect to strength, whether you had a stronger sleeve or not, but if you keep within the allowable tightening torque that will not result in a permanent distortion of the sleeve, you can use a greater allowable tightening torque with a higher

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strength sleeve than you could with a sleeve of a low strength material. In other words, it increases the maximum tightening torque that you can use without locking of the sleeve and the nut or other damage to the fitting if you use a higher strength sleeve.

Q. 150. Does the sleeve head angle bring that about? A. That is right.

Q. 151. To prevent the locking? [56]

A. That is one of the purposes of the sleeve head angle, to allow the use of higher tightening torques in order to assure pressure-tight seals on higher pressure systems without permanent damage to the coupling and with the minimum of use or damage on the tube flare.

Q. 152. Does the Parker type flared fitting have a self-locking feature? A. Yes; it does.

Q. 153. Is that brought about in any way by the sleeve head angle? A. Yes.

Q. 154. Will you explain that?

A. As the nut is tightened onto the fitting body with sufficient torque to make a pressure-tight seal between the sleeve head and the nose on the body, the sleeve head extends out at the toe or at the point where it contacts the flare. There is a wedge action between the toe of the sleeve and the outside of the flare. As the threads on the nut are pulled down, the sleeve is pulled down against this angle on the flare, and the flare tends to wedge the nose of the sleeve out to a larger diameter. In other words, it spreads at the nose.

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Q. 155. And that causes a self-locking?

A. Well, in spreading it at the nose, so long as you do not spread it sufficiently to permanently distort it, [57] you create a stress in the nose of that sleeve which is continually trying to make it go back to its original size and it provides a continuous grip on the flare.

Q. 156. Does that put the sleeve under tension at the nose?

A. Yes; the nose of the sleeve where it is expanded is under tension continuously while it's assembled.

Q. 157. Is there a commonly known term for the tension at the nose of the sleeve?

A. Yes; that kind of stress is known as hoop stress.

Q. 158. Or hoop tension?

A. Hoop tension or hoop stress.

Q. 159. Did you ever hear of wire locking of threaded parts together?

A. Oh, yes; we do a great deal of that in our plant on assembled valves.

Q. 160. Is that used in the aviation field at times?

A. Yes; it's used very extensively on our aviation products. We are required, in order to meet specifications for valves and similar accessories, to wire-lock parts that are threaded together or screws which are threaded into parts to hold parts together. Wire-locking is for the purpose of preventing them from loosening under vibration.

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Q. 161. Is wire-locking required in the Parker type flared fitting? [58]

A. No; it never has been required. The fittings have been used always without any special locking provision.

Q. 162. Was that because of the hoop tension that you just mentioned on the nose of the tube?

A. The hoop tension on the nose of the sleeve——

Q. 163. Sleeve. Pardon me.

A. ——does assist very markedly in making it unnecessary to provide any special locking between the parts of the fitting to keep them from unthreading.

Q. 164. In other words, when the parts are screwed down, there is a locking feature that prevents them from being easily unscrewed because of that hoop tension; is that correct?

A. Yes; that is correct. The hoop tension in the sleeve means that it is trying to contract back on a wedge-shaped surface which is the outside of the flare, and if it is to contract, it must back away, that is, slide down the angle of the flare, which means that in turn has to move back on the fitting, and that keeps a stress on the threads between the nut and the body, pulling them in contact all the time under this tension, which tends to prevent them from loosening.

Q. 165. Does that overcome any vibration tendency to unloosen the fitting?

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A. Yes; it has not been necessary to provide any [59] additional lock on these fittings under any conditions that I have ever seen or heard of, irrespective of how much vibration may be present, in order to prevent loosening.

Q. 166. Just what do you mean by wire locking? What does that comprise?

A. When two parts are threaded together, such as a nut on a bolt or a screw into a unit, you drill a hole through the head of the screw and a hole through the mating unit and run a small sized wire through those two holes in such a fashion that any tendency of one part to turn with respect to the other part must stretch or break the wire. In this case, to wire-lock it, you would drill a hole through the nut and a hole through the body, probably on the hexagon section where it is marked "body" on Exhibit 2, and connect the nut with that portion of the body by a wire running through the holes in each part, and the wire directed around the two parts so that any loosening motion of the nut would stretch or pull the wire, which has already been pulled up tight when the wire-lock was put on.

Q. 167. What can you say about wire-locking fittings, for example, in close, cramped quarters that you spoke of in your former testimony?

A. Well, wire locking of any kind is a nuisance and a headache and costly, even in production where you are working [60] on a bench, and if it were necessary to reach in in the very close quarters where many of these fitting assemblies are

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made as joints on the end of a line and find those small holes and get the wire through them and pull it up tight, it would be a headache of the greatest order. I can't see how it would be possible to do it on many of the installations that I have seen.

Q. 168. Is there any problem in flared type fittings of over-tightening?

A. Oh, yes; there is definitely a problem, particularly in the small sized fittings and particularly in small sized fittings with soft tubing. The normal torques required to make a pressure-tight seal on small sized fittings are so much lower than the torques that mechanics use when they tighten up screws and bolts and similar things that there is a natural tendency to pull them up too tight, which has been the cause of trouble many times and requires a lot of precautionary instructions to avoid such over-tightening.

Q. 169. Does the Parker type flared fitting shown in Deposition Exhibits 1 and 2 have any provision for lessening the possibility of over-tightening, or the ill effects therefrom?

A. There are several features of the fitting shown in Exhibits 1 and 2 which assist in preventing damage under [61] over-tightened conditions. In fact, these fittings, in order to pass the tests called for in the specification which was introduced as Exhibit 6, require repeated assemblies at two and a half times the maximum recommended torque for each size fitting, and for aluminum tubing on the one hand and steel tubing on the other hand there

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are standard recommended torque ranges provided, and in the AN Standard sheets, there is a minimum and maximum recommended, which is intended to give a range for practical installation purposes, but either of which is intended to be entirely satisfactory as far as maintaining a pressure-tight seal and resistance to vibration, but the coupling, in order to be satisfactory, has to withstand 15 assemblies and disassemblies at two and a half times the maximum torque. The use of a sleeve head which can be expanded without damage is of value in preventing damage due to over-torqueing.

Q. 170. Is that expansion due to the provision of the sleeve head angle?

A. The fittings, in order to be satisfactory, must be still usable after 15 assemblies or disassemblies and re-assemblies at two and one-half times the maximum recommended torque, and the sleeve head angle is definitely of value in that sense in that the fittings must be usable and the sleeve must not be permanently locked in the nut, even at such torques. [62]

Q. 171. Does the sleeve head angle in the Parker type fitting shown in Exhibits 1 and 2 have any advantage in so far as compensating for manufacturing inaccuracies? A. Yes.

Q. 172. State what they are.

A. The AN Standard drawings for the AN flared fitting, which Exhibit I here is typical, set up the specific detailed dimensions to which each of these

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parts are to be manufactured, and provide tolerances for those dimensions, and the procurement specification, which was Exhibit 5, calls for quality controls on finishes. However, in even precision manufacture of this type or high quality machine work of this type, there never is a perfect job. Parts tend to be slightly eccentric, considering one diameter with respect to another on the same piece, or the diameter of a thread with respect to some other machined part of a nut. The nose of the fitting may even be slightly oval. Those irregularities, which are each one by itself small, still are important when you have to make the flare on the tube contact and conform with the nose of the fitting, even with those irregularities or eccentricities. The sleeve, being a separate portion from the nut, and having provision for expansion at the tip, due to the sleeve head angle, introduces a feature in this fitting which more readily allows adjustment of the sleeve angle or the sleeve head [63] angle to the tube. If this were a rigid fitting, the distortion necessary to make the parts conform in order to get a good seal, despite small irregularities, will have to be taken either in the heavy section one-piece nut or the nose of the fitting or on the tube. With an aluminum tube it would be almost on the tube, which means that it might readily be unduly damaged. The flexible end of the sleeve can actually become oval under this hoop stress rather than remain exactly round, if necessary to conform with some irregularity on the flare.

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Q. 173. Then this hoop tension that you spoke of provides a uniform-bearing pressure or loading on the sleeve even though there are some manufacturing eccentricities; is that correct?

A. Yes; that definitely assists in accomplishing a uniform loading on the sleeve, and that will be particularly true where you use hard tubing such as steel or stainless steel tubing, which in itself sets up a strong resistance to deforming.

Q. 174. Does that uniform-bearing pressure assist in getting a tight seal?

A. Yes; it does. If it's necessary to distort a flare at one point in order to insure the minimum sealing contact at the other, in the first place, a high torque would be required, and these fittings are assembled under [64] controlled torque instructions. Once the installation is complete, leakages normally will be quickly found, but if it is just at the point where it might leak, the leak may not show up until later.

Q. 175. Does the hoop tension and uniform-bearing pressure have any effect as far as the possibility of pulling the tube out of the fitting is concerned?

A. On soft tubing the hoop tension in the sleeve head, just like the initial pressure on the sleeve head, tends to bite into the tube, and if there is no follow-up in the fitting to keep pressing, even though something may move, such as the tube flare gradually thinning a little bit, if there is no fol-

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low-up to keep that pressure on there, it might pull out.

Q. 176. Does the sleeve head angle increase the range of permissible wrench torques in any way?

A. Yes; it does. I think we have referred to this under a previous question.

Q. 177. How does it increase the range in the Parker flared fitting?

A. It allows a lower minimum range for an acceptable seal, because the sleeve head angle and the resulting ability of the sleeve head to conform to irregularities means that you can allow a lower minimum torque and still feel sure of a seal. On the maximum torque range, we are [65] limited primarily, on all of the small sizes of fittings particularly and to a lesser extent on the larger ones, by the maximum torque that can be permitted without damage to the fitting, and the sleeve head angle, in combination with this expansion of the sleeve at the toe which you get, allows you to use higher torques without damage.

Q. 178. I hand you a fitting, marked for identification as "Amon Deposition Physical Exhibit 7."

(Fitting marked, "Amon Deposition Physical Exhibit 7.")

Q. 178. (Continuing): How does that compare with the drawing, Exhibit 2?

A. This Exhibit 7 is a fitting that is typical of that shown on the drawing, Exhibit 2. It is a smaller size fitting. The body and nut and sleeve are steel and the tubing is steel.

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Q. 179. Likewise, the fitting marked for identification "Amon Exhibit 7," has a cutaway portion; is that correct?

A. Yes; that is correct. It is like Exhibit 1 in that it obviously has been assembled and then cut away to show the internal seat on the flare.

Q. 180. Is that a Parker type flared fitting?

A. Yes; that is correct. It was made by Parker.

Q. 181. And is that an AN flared fitting?

A. Yes; this is one of the AN flared fittings. The black [66] color on the steel fitting is used by Parker on the AN fittings.

Mr. Van Sciver: I offer this fitting, marked for identification "Deposition Exhibit 7," as Exhibit 7.

Q. 182. I hand you a drawing marked for identification as "Amon Deposition Exhibit 8."

(Drawing marked, "Amon Deposition Exhibit 8.")

Q. 182. (Continuing): Will you explain what that drawing illustrates? And in your explanation you might mark it with the same legends, where applicable, as Exhibit 2.

A. The drawing Exhibit 8 is also a typical Parker type AN fitting and differs only from the drawing Exhibit 2 in that the sleeve angle is different. This drawing Exhibit 8 shows the double differential angle on the sleeve and would be used with a soft tubing.

Q. 183. Will you mark on the drawing Exhibit

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8 what you have called the double differential angle?

A. (Witness does as requested.)

Q. 184. Do you know the angle of the double differential angle which is the lesser of the two?

A. The lesser angle is the one starting close to the original outside diameter of the flare. Now, that angle is 18½ degrees. [67]

Q. 185. Will you mark that?

A. Mark the angle? (Witness does as requested.)

Q. 186. And then what is the angle of the second double angle?

A. The other angle of the double angle is out at the toe of the sleeve where it rests against the outside of the flare, and that angle is 33 degrees.

Q. 187. And the angle of the outside of the flare is also 33 degrees; correct?

A. Yes; the angle of the outside of the flare is approximately 33 degrees.

Q. 188. And the inside 37 degrees; correct?

A. That is correct; the inside angle is 37 degrees.

Q. 189. Would you mark on the drawing Exhibit 8 the same legends that you have placed on Exhibit 2; that is, body, flare, and so forth?

A. (Witness does as requested.)

Q. 190. Is that drawing Exhibit 8 exemplary of a Parker AN flared fitting, the type of Parker AN fitting?

A. Yes; it is exemplary of one of the small sizes of this group of fittings. The double differential

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angle is used only on the sizes from No. 2 to No. 6, inclusive, which are for 1/8 inch O.D. tubing up to 3/8 inch O.D. tubing, and it is used only with those sizes where aluminum tubing is used with the fittings [68]

Q. 191. In other words, that double differential angle is not used on steel tubing as exemplified by Deposition Exhibit 7; is that correct?

A. That is correct. Exhibit 7 is a size 4 or 1/4 inch fitting, but is used with steel tubing and does not use the double differential angle.

Q. 192. I hand you a fitting encased in plastic, which we will mark for identification as "Amon Deposition Exhibit 9."

(Fitting marked, "Amon Deposition Exhibit 9.")

Q. 192. (Continuing): I will ask you if that is the same type of fitting that is shown in the drawing Exhibit 8?

A. Yes; this fitting, Exhibit 9, is a cutaway assembled fitting of the No. 5 size used with aluminum tubing and includes the double differential angle as shown in Exhibit 8.

Q. 193. Is that a Parker flared type fitting?

A. Yes; it is. It carries the Parker trade-mark.

Q. 194. And it is also an AN flared fitting?

A. Yes; it is. It is marked "AN" and the blue color identifies it as AN.

Mr. Van Sciver: I offer the drawing, marked for identification as "Deposition Exhibit 8," in evi-

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dence and also the physical [69] device, marked for identification as "Deposition Exhibit 9," in evidence.

(Thereupon, at 5:25 p.m., an adjournment was taken until Friday, May 6th, 1949, at 9:00 a.m. [70]

Friday, May 6, 1949, at 9:00 A.M.

Appearances:

As before.

Direct Examination
(Continued)

By Mr. Van Sciver:

Q. 195. Mr. Amon, with respect to the sleeve head angle on the outside of the sleeve of the flared fittings, does that angle have any effect with respect to the contact between the sleeve and the nut shoulder?

A. Yes; that permits achievement of the maximum area of contact between the sleeve head and the nut shoulder.

Q. 196. How does it do that?

A. The coupling in any one size is designed for a minimum size while still meeting the necessary performance requirements. For any one size coupling you start with an outside diameter of this tubing with which the coupling is to be used. This fitting, Exhibit 1, is a No. 8 fitting for one-half O.D. tubing. It's desirable to use the smallest di-

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ameter thread that is possible for the fitting body and for the nut. The space between the diameter of the thread and the outside diameter of the tube is all the space that remains into which the coupling parts have [71] to be incorporated. A part of that space is taken up by the necessary thickness of the shank of the sleeve where it extends back along the tube, and sufficient clearance must be provided to permit sliding the sleeve over the tube and sliding the sleeve through the nut. When those thicknesses and clearances are deducted, what's left is the maximum width of nut shoulder, and it follows that it is desirable to have that matched by the maximum possible width on the sleeve shoulder.

Q. 197. What is the advantage of having the sleeve and nut shoulder in contact at a maximum?

A. The contact between the sleeve and nut shoulder represents a bearing. It takes a bearing load, like a thrust bearing. When the nut is engaged on the body, the nut shoulder exerts pressure on the sleeve shoulder, as in a bearing, and it is necessary to keep that unit bearing pressure within certain limits or the fitting will not function properly, will not assemble and disassemble properly. It isn't necessary to hold any one given unit bearing pressure, just so long as the fitting functions properly. And if we can do that within the limitation of the smallest possible thread, we have a lighter coupling that will still perform all right.

Q. 198. When the sleeve head expands, that you

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have testified that it does, does it move forward with respect [72] to the flare of the tube?

A. Yes; the whole sleeve head must move forward with respect to the tube and the tube flare as it expands.

Q. 199. And that happens when the nut is tightened or brought home; is that correct?

A. That is correct.

Q. 200. Does that have any effect, the fact that the tube head can expand, on distorting or destroying the flare, preventing destruction or distortion of the flare?

A. Yes; it does in several respects. If we visualize the coupling assembled with soft tubing and consider that along with the fact that the mechanic in assembling the nut will pull it up to a required wrench torque, you find in a coupling of this type with a sleeve head that can expand that some of the energy put into making of the coupling by the mechanic is taken up in distortion of the sleeve head rather than entirely on distortion of the flare.

Q. 201. Referring to Deposition Exhibits 8 and 9, does that type of coupling also have an outside sleeve angle on it?

A. Yes; that's correct. That's marked "Sleeve head angle" on this Exhibit No. 8.

Q. 202. Is everything that you have said with respect to the sleeve head angle applicable to the couplings shown, [73] for example, in Exhibits 8 and 9?

A. Yes; that's right. Most of the previous ques-

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tions were about fittings shown in Exhibits 1 and 2.

Q. 203. So far as the sleeve head angle itself is concerned, is what you have said about 1 and 2 equally applicable to Exhibits 8 and 9?

A. Yes.

Q. 204. I notice on Exhibit 8 the term "Double differential angle" on the sleeve. Will you explain that terminology?

A. Yes; that's my own name for it. It is a double angle in that on the exhibit two separate angles are indicated by the arrows. One of these angles is at the very toe of the sleeve where it is in contact with the flare. That angle is marked "33 degrees." The other angle on the sleeve is marked as "18½ degrees." These two angles make a double angle. The differential angle is the angle between the 18½ degree angle and the matching 33 degree angle on the outside of the flare of the tube.

Q. 205. Does that smaller angle provide initial toe contact between the sleeve and the flare of the tube? A. Yes; it does.

Q. 206. Is that sometimes referred to as differential angle? [74]

A. Yes; that is what I refer to as differential angle.

Q. 207. Will you tell us what advantage, if any, there is in having initial line contact between the sleeve and the flare of the tube?

A. Initial line contact——

Q. 208. Or toe contact.

A. I was going to say that initial line contact

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on a soft material here such as aluminum tubing would not necessarily be any advantage or even desirable, whereas it might be on steel tubing, because you get a better pressure seal with a line contact, the general design principle, than you do with area contact. However, we have to use more than line contact on aluminum tubing in order to get enough assembly tightening on the fitting to give us proper joint makeup and resistance against loosening. That is, to establish any of the hoop tension that we spoke about before. Toe contact, as different from line contact, is desirable. The fittings shown in Exhibit 8 are used only in the small sizes; that is, up through sizes 3/8 inch O.D. tubing and with aluminum tubing, which is relatively soft compared to a steel or stainless steel tubing. With aluminum tubing and with fittings of sufficiently rugged construction to stand up in service in these small sizes, it's desirable to do anything possible to [75] assist in getting the desired sleeve head expansion with the lower torques that we are dealing with, and, thus, making provision for contact at the very toe assists in setting up these desired conditions.

Q. 209. When the nut on the fitting shown in Exhibit 8 is brought home or tightened, is it true that the space that is shown on the exhibit between the sleeve nose and the flare of the tube more or less disappears? A. Yes; that is correct.

Q. 210. That space closes up?

A. That space closes down in this fashion: in

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tightening these fittings with any recommended torque range on aluminum tubing, the toe of the sleeve as it is pulled down on the flare does expand and at the same time it actually bites into the metal of the flare and sinks itself in in such a manner that the 18½ degree angle shown on Exhibit 8 will also come in contact with the surface of the metal on the flare.

Q. 211. Then the drawing as shown, Exhibit 8, shows the parts before they are tightened up; is that correct? A. Yes.

Q. 212. Before they are fully tightened?

A. That is correct. This drawing would indicate that practically no wrench torque had been put on. In other words, finger tight; just pulled up in close contact. [76]

Q. 213. Does the differential angle of the fitting of the type shown in Exhibits 8 and 9 have any effect with respect to increasing or decreasing the resistance to vibration fatigue?

A. Yes; it does, particularly when a fitting of the size shown in Exhibit 8 is used on aluminum alloy tubing. Under vibration, the common point of failure of a joint is at the base or heel of the flare. That is where the flare angle meets the original tube wall. On the small sized fittings in particular there is a real risk of over-tightening, which may be ignorant or inadvertent but which in any case is still harmful to the fitting. The type of fitting shown in Exhibit 2, if used on aluminum tubing in these small sizes where we frequently find

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over-tightening, would almost completely pinch off the flare right at the base, leaving practically no metal there to resist vibration at its weakest point. When the differential angle is used, as shown on Exhibit 8, the over-tightening of the fitting at its very worst can no more than bring the toe of the sleeve in contact with the nose of the fitting by actually cutting the tip end of the flare clear off. As I said, that is at the worst condition. And even if you have such tightening, the point of cutoff of the flare as it's pinched between the very toe of the sleeve and the nose of the fitting will be out at some considerable [77] length away from the base of the flare. You will then have a shorter flare but one at least with a high per cent of its original length that is gripped between the 18½ degree angle and the nose of the fitting.

Q. 214. You mentioned the fact that the nose of the sleeve would dig in to the flare slightly when the fitting is taken up. Is that due to the initial toe contact?

A. Yes; that's true. With this double angle sleeve, which is also called a modified sleeve, and it's also called a wedge-type sleeve, the 33 degree angle on the sleeve makes a narrow contact with the surface of the flare at the toe. That's what we spoke of as toe contact.

Q. 215. What is the extent of that surface on these fittings, do you know?

A. On the AC811 fitting, that is represented by a dimension on the drawings from ten thousandths

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to twenty thousandths of an inch, one being the minimum, the other the maximum.

Q. 216. AC811 or AN?

A. That is on the AC811. On the AN it is shown in a similar fashion. I am quite certain that that dimension is twenty-five thousandths of an inch with a small tolerance allowed. It's quite narrow.

Q. 217. Is there any advantage, and, if so, what is it, of the sleeve digging into the flare of the tube slightly, [78] as you have mentioned?

A. To have a sleeve which digs into the flare of the tubing slightly, particularly if that digging-in point is not immediately at the base of the flare or quite close to it, does have several advantages. If you would visualize this as used with hard tubing, a slight digging in on a very narrow contact would be ideal from a pressure-seal standpoint, but that digging in should be only slight in that case. With soft tubing, a digging-in at a distance away from the base of the flare tends to set up a bulge of metal on the end of the flare outside the toe of the sleeve, which in turn is resistant to pull-out.

Mr. Van Sciver: That is all. You may cross-examine.

Cross-Examination

By Mr. Beehler:

XQ. 218. Mr. Amon, when you first began your testimony yesterday, you mentioned the Parker fitting. What do you mean by the Parker fitting?

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A. Well, there are several fittings that are known as the Parker fitting. There are several fittings that I might refer to as the Parker fitting. In connection with these exhibits here, I refer to Exhibit 1 as a Parker fitting. [79]

XQ. 219. That isn't the only Parker fitting, though?

A. No; you are correct. Parker does make fittings other than this particular one.

XQ. 220. When you say that that is a Parker fitting, do you mean that that is a Parker fitting because of the dimensions and proportions, or because it was made by Parker?

A. Well, I mean both. The answer to the first is obvious, "Made by Parker," it would be a Parker fitting, but when I speak of a Parker fitting, or Parker-type fitting, I am thinking of the Parker three-piece type fitting with nut, sleeve, and body, and with these various features in it that we have discussed.

XQ. 221. Well, is it true, then, that you call it a Parker type fitting because it is a three-piece fitting?

A. Not that alone. There have been several Parker three-piece type fittings in the sense only of slight changes and improvements.

XQ. 222. Have they all been used on aircraft?

A. Yes; the Parker three-piece type fittings have all been used on aircraft, with the exception of certain very heavy and large size fittings that have been designed only for industrial applications.

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XQ. 223. Now, tell me, is it your contention, Mr. Amon, that the AN Standard fittings, that is, fittings made in accordance with AN standards, are synonymous with the [80] Parker fitting?

A. Yes; I consider them so.

XQ. 224. That is, is it your contention, then, that Parker originated the dimensions and proportions of the AN Standard fitting?

A. I would like to answer that with a little explanation, if I may.

XQ. 225. Sure.

A. I'd say that speaking in general the answer is yes. However, I don't mean to imply by that that every single dimension on this fitting was copied exactly from a Parker fitting. That would be an erroneous statement if I were to say so.

XQ. 226. Well, can you tell us which ones were copied from the Parker fitting?

A. I couldn't tell you exactly which dimensions were copied from a Parker fitting without actually comparing the drawings in detail right here now. The basic dimensions and proportions, I say, were copied in the sense that this fitting design and the details of it are only modifications or slight changes in the basic proportions and dimensions of the Parker fitting.

XQ. 227. Well, with respect to the angle on the body, is that copied from the Parker fitting?

A. Not exactly. There is a small [81] difference.

XQ. 228. On this fitting, throughout the whole

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series the angle on the body—that's the nose of the body—is 33 degrees. In the Parker fitting, that angle varies from approximately 35 degrees to as low as 25 degrees on different sizes.

XQ. 229. And on which series of fittings is that?

A. That is the Parker three-piece triple coupling, the one that I refer to as the Parker type fitting, which is the basis of this design. That's the AC811 fitting.

XQ. 230. Are you familiar with the NAF standards for fittings?

A. Yes. Not in as great detail as I am the Parker or AN series.

XQ. 231. You know, do you not, that the angle on the nose of the body of the NAF fitting is 33 degrees; isn't that true? A. Yes; that's true.

XQ. 232. Did Parker originate that angle?

A. The Parker Size 4 and 5 fittings, that is, the AC811 series, have either a 33 degree angle on the nose or one very close to it.

XQ. 233. Do you know which came first, the NAF or the Parker?

A. In that size fitting, speaking of Sizes 5 and smaller, any Size 5 and smaller, which includes the one I [82] just mentioned, the No. 4, that angle was on the nose of the fitting even before 1936 when I started with Parker. I don't know when it was put on exactly prior to that time.

XQ. 234. With respect to the nut of the NAF fitting, you are aware, are you not, that there is a conical internal flare on the nut which is designed to fit against the flare on the tube?

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A. A conical seat on the nut?

XQ. 235. Yes; seat, if you choose to call it that. A. That is correct; yes.

XQ. 236. Do you know the angle of the seat of the nut of the NAF fitting?

A. I don't know at this time exactly what that angle is.

XQ. 237. That's 33 degrees, is it not? Excuse me. So as not to confuse you, I spoke of the body as having a 33 degree angle. I believe the body has a 37 degree angle; is that correct?

A. I can't answer specifically on the difference between 33 and 37, the angles are so close together. I do know that the angle on the nose of the fitting in the NAF series was a different angle by some small amount than the angle on the seat surface in nut.

XQ. 238. On the AN fitting, Mr. Amon, what is the angle on the nose of the body? [83]

A. On the AN fitting, the angle on the nose of the body is 33 degrees. No. Pardon me. The angle on the nose of the body is 37 degrees.

XQ. 239. And then the angle which you called here the sleeve angle is what on the AN?

A. That is 33 degrees on the sleeve used with large sized fittings, and on small sizes, that is, up to the 3/8 inch or No. 6 size, you have the double angle, which is made up of 33 degrees and 18½ degrees.

XQ. 240. Tell me, the relationship wherein the body has an angle of 37 degrees contacting the in-

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side of the flare and the sleeve inside angle of 33 degrees contacting the outside of the flare, did those angular relationships originate with Parker?

A. The answer to that question is that those specific angles did not appear as such in the Parker 811 fitting, although as I stated a bit ago, there were in the AC811 series of fittings different angles of those two surfaces that you mentioned.

XQ. 241. Tell me, are those angular relationships important?

A. Well, I can't say that they are not important. They are one of the things that is desirable in the design of a good coupling.

XQ. 242. Are those angular relationships critical? [84]

A. I hesitate to say that they are critical, although they may be critical under certain conditions of assembly or with certain types of fittings. If you speak about the AN fitting as it is presently shown on the AN standard drawings, and when we talk of the larger sizes of fittings used with soft tubing or when we talk of steel tubing, I don't consider those angles themselves as being critical.

XQ. 243. Well, suppose just for a moment we mention the smaller sizes where the sleeve is as pictured in your Exhibit No. 8. Are the sleeve head angles there critical?

A. Yes; they are critical there, since this sleeve is used with soft tubing and in small sizes.

XQ. 244. Did that double differential angle originate with Parker?

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A. You ask, did that double differential angle originate with Parker?

XQ. 245. Yes.

A. Well, I can't say that that particular double differential angle originated with Parker. That double differential angle is something very specific there, 33 degrees and 18½ degrees, and it also represents a fitting in which the 33 degree angle is of a given specific length, and I can't say that those details originated with Parker. In fact, I don't believe they did exactly as those details are shown. [85]

XQ. 246. Well, the idea of the double differential angle did not originate with Parker; isn't that so?

A. I think I can say that that is so, answering the question as you put it, that the double differential as shown there probably did not originate with Parker.

XQ. 247. The idea of the double differential angle did not originate with Parker; isn't that correct?

A. I hesitate to answer the question when you say "double" and "differential." They are two different things entirely.

XQ. 248. Well, I don't mean to confuse you, Mr. Amon. What I mean to ask you is: Here in your Exhibit 8 on the inside of the sleeve you show a flare which is at two different angles, namely, 18½ degrees and 33 degrees. Now, irrespective of the precise number of degrees, there are two different angles on the inside of the sleeve; correct?

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A. Yes.

XQ. 249. Did the idea of using two different angles on the inside of the sleeve originate with Parker?

A. I believe I can answer that no, not to my knowledge, did that originate with Parker.

XQ. 250. One more question about this particular kind of sleeve shown in Exhibit No. 8. Is the drawing of Exhibit 8 drawn to correct proportions? I appreciate that it's enlarged [86] some.

A. Yes; that drawing, certainly with respect to the proportions of the various elements shown on the drawing, one with respect to the other, it could be an enlargement of an actual fitting.

XQ. 251. I lay my pencil, Mr. Amon, on the portion which you have designated "33 degrees," and that 33 degree portion has a certain length. Now I lay my pencil on the portion which you have designated "18½ degrees," and that portion has a certain length. What is the proportion of the 33 degree length to the 18½ degree length? Is it half as long, or a third as long, or what?

A. On this particular drawing here, Exhibit No. 8, the 18½ degree angle flat surface is longer than the 33 degree. I can't say exactly how much longer it is on any one size, and it may not be exactly the same on one size as on another size, but this one appears to be 25 to 50 per cent longer, just from looking at the drawing.

XQ. 252. Thank you. Now, Mr. Amon, the relationship of the parts in Exhibit 8 are shown prior

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to the drawing up of the nut; is that right?

A. On Exhibit 8, the relationship of the parts indicates, I said, finger tight, but no distorting for full load pressure being put on.

XQ. 253. What is the specified clearance in the sizes [87] depicted in Exhibit 8 between the exterior of the butt end of the head on the sleeve and the interior of the surrounding portion of the nut?

A. On the basic drawings, that clearance is a few thousandths of an inch.

XQ. 254. How many thousandths?

A. I can't answer that question without checking the drawing as to exactly how much it is. There is a slight tolerance there, but beyond that only sufficient clearance to enable the sleeve head to slip inside the nut.

XQ. 255. Is not the clearance five one-thousandths of an inch?

A. Will you repeat that, please?

XQ. 256. Is not the clearance five one-thousandths of an inch?

A. That would be a reasonable clearance. I can't say that that is exactly the clearance.

XQ. 257. That's what the specifications call for; isn't it?

A. Well, I could check it by looking at the drawings. I do not keep all those details in my head. I don't remember the specific drawings.

XQ. 258. Do you have the drawings here?

A. Yes; the drawings were submitted as an exhibit.

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XQ. 259. Will you refer to them, please, and check that [88] dimension?

A. Will it be satisfactory if I check one size?

XQ. 260. Certainly.

A. I am not even certain that these clearances are the same for all sizes.

XQ. 261. Check any size from the 2 to 8, any one of them.

A. On the No. 4 size, that basic clearance is five one-thousandths of an inch.

XQ. 262. Point out, will you, please, the clearance on Exhibit 8. Is the clearance shown there between the head of the sleeve and the inside of the nut?

A. Yes; there is clearance shown there.

XQ. 263. Will you point it out?

A. Very small clearance. You wish me to mark it? I can't mark it on the exhibit. It's right here at the heel. The two lines do not join in that there is a very narrow continuous white space between those surfaces. Is that what you speak of?

XQ. 264. That is right. Is that in correct proportion to the rest of the drawing?

A. Well, I would say that in my opinion it is.

XQ. 265. Very well. You have labelled on this drawing an angle which you have called the "sleeve head angle." That sleeve head angle is, in fact one and a half degrees, is it not? [89]

A. It's one degree, consulting the exhibit. I have just looked at it here.

XQ. 266. One degree? Very well. And the

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nose or tip of the sleeve, how much more clearance is there due to that sleeve head angle than there is at the base of the sleeve?

A. I couldn't answer that question exactly without calculating it or making an actual scale layout to measure it.

XQ. 267. Well, actually——

A. It will be some greater.

XQ. 268. Actually, it's about four one-thousandths, isn't it?

A. I can't say whether it's four one-thousandths greater—is that it?

XQ. 269. Greater clearance.

A. Greater clearance. I have never had occasion to check that specific clearance on loose unassembled fittings, so I say that your figure is probably—appears to be reasonable, but whether it's accurate or not, I can't say.

XQ. 270. Well, I appreciate that you can't figure those things in your head, but referring again to the drawing Exhibit 8, there is considerably more clearance shown there at the tip or free end of the head than there is at [90] the base of the head; is there not? A. Yes.

XQ. 271. And there is a far greater amount of clearance shown at the tip on the drawing than at the base; that is true, isn't it?

A. Yes; from the drawing, it would just appear that there is approximately at least twice as much clearance.

XQ. 272. Yesterday in your direct testimony

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you gave us considerable information about the advantages of tubing lines, I believe it was, in aircraft construction, and you mentioned among other things the fact that vibration is a big factor in aircraft design. Am I correct?

A. That is correct.

XQ. 273. And that a fitting which is capable of reducing vibration is better in that respect at least than one that is less capable of resisting vibration; isn't that true? A. Yes.

XQ. 274. It is true, is it not, Mr. Amon, that the flared fittings, the standard flared two-piece fittings, have a far greater capacity for resisting vibration than the three-piece fittings?

A. You refer to what two-piece fitting?

XQ. 275. Well, the NAF, for example.

Mr. Freeman: Beehler, can we agree that [91] when you were referring to an NAF fitting in your early questions of this witness that you were then talking about a two-piece fitting as distinguished from a three-piece fitting; is that correct?

Mr. Beehler: That is correct.

A. To answer your question, Mr. Beehler, it is not my belief that the NAF two-piece fitting is superior to the AN three-piece fitting under vibration. Now, I will have to go further by saying that there are a great many ways that vibration can be tested. With different types of equipment, with different kinds of tubing material and different sizes of fittings and different lengths of tubing. But when I say that I do not believe it is superior,

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I am speaking about performance in service, and it's certainly not feeling that it's superior on an over-all basis.

XQ. 276. There is a question in your mind, then; is that correct?

A. There is no question in my mind about performance in service.

XQ. 277. But so far as testing is concerned, there is a question in your mind; is that correct?

A. There is a question in my mind only to this extent: that tests, vibration laboratory tests, don't mean a thing unless you have something to compare with something [92] else. Now, most of those tests are tests on the tubing only, and it's very difficult to set up a test procedure that will give you a test on a joint rather than on the tubing itself.

XQ. 278. Is it your contention, then, that tests have no value?

A. Absolutely not. I certainly can't say that tests have no value. Tests are always of great importance in a preliminary evaluation and in searching out weaknesses, but I certainly would not say that you can duplicate service conditions in a laboratory test program, and I am sure that that's the common basis under which laboratory tests and development work is carried out through the whole aircraft industry.

XQ. 279. You are aware, are you not, that the NAF two-piece flared fitting is still quite widely used in aircraft construction?

A. In my opinion, the NAF fitting is used to

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a very limited extent in aircraft construction. There are some airplanes in service for which those parts are still ordered by the Navy as service parts, but although there are possibly a considerable number of individual fittings in service, the quantities of such fittings that are manufactured and sold today are far less than the AN Standard fittings. [93]

XQ. 280. One thing further with respect to vibration. You mentioned in your direct testimony that unsupported lengths of tubing had a tendency to whip and cause rupture at the joint; is that correct?

A. Yes; in tubing installations on fluid systems in airplanes in high velocity circuits, as on hydraulic systems, unsupported sections of tubing tend to whip under the action of the fluid flowing through them. The standard installation requirements call for a clamping of tubing to a supporting portion of the airplane at given lengths.

XQ. 281. Then when the tubing is properly supported, the vibration damage is greately minimized; that's true, isn't it? A. That is true.

XQ. 282. And when the vibration damage is minimized, the importance of the fitting to resist vibration is diminished; that's true, isn't it?

A. That is true.

XQ. 283. Are you familiar, Mr. Amon, with breakdown tests on the triple fitting, tests made to determine failure of the triple fitting?

A. When you say the "triple fitting," do you mean the AC811 fitting?

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XQ. 284. Well, let's say, for example, the AC811. [94]

A. There have been a great many tests at different times run on fittings including the AC811 fitting, laboratory tests.

XQ. 285. Is it not true that the most common failure in the AC811 fitting is a failure of the sleeve?

A. Not a failure of the sleeve; no. That is a very uncommon failure in the 811 fitting.

XQ. 286. Well, that's true in the AN fitting, then, isn't it?

A. No. Now, may I ask you what you mean by the failure of the sleeve?

XQ. 287. Fracture of the sleeve.

A. I assume you mean fracture of the sleeve.

XQ. 288. Fracture of the sleeve.

A. No; that is uncommon as a failure in the AN fitting, fracturing of the sleeve.

XQ. 289. You also made some point yesterday, Mr. Amon, of the crash of DC-6's; am I correct?

A. Yes; I did.

XQ. 290. And they were due to tubing failures?

A. No; if I remember, I said specifically that that was not due to the tubing failure. I was referring to the hazard of gasoline.

XQ. 291. You spoke, I believe, of fittings in aircraft, triple fittings, for example, leaking on occasions. What [95] do you do when a fitting leaks a little bit?

A. When a fitting leaks it should be inspected

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to see if there has been any damage to the parts. If the fitting is relatively loose, that is, if it can be loosened with less torque than required to loosen one that has been properly assembled, there is a strong possibility that the leak is due to the fitting not having been properly tightened. On the other hand——

XQ. 292. May I interrupt?

A. ——it would be foolish just to tighten them and assume that that's the trouble. They should be inspected.

XQ. 293. But you can repair a leak by tightening the fitting a little bit more; that's true, isn't it?

A. That is true in many cases. If there is nothing damaged in the fitting or on the flare.

XQ. 294. With respect to failures of fittings, is it not true that the most common failure is a pinching off of the flare in flared fittings?

A. On aluminum alloy tubing, which is soft tubing, pinching off of the flares are a common failure, but are less common today than they were, say, five years ago in that changes have been made in the fittings used with the small sizes of aluminum tubing where this pinching off of the flare was at one time quite a problem and these changes have minimized that trouble. [96]

XQ. 295. The pinching off failure is, however, more prevalent in the three-piece fitting than it is in the two-piece fitting; isn't that true?

A. Yes. I answer that yes, speaking of small sized fittings with soft tubing.

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XQ. 296. Yesterday also, Mr. Amon, you spoke of the advantages of using seamless tubing, I believe it was, instead of iron pipe as conduits in aircraft. You made that comparison, did you not?

A. Yes.

XQ. 297. When was the last time you saw iron pipe used as a fuel line for aircraft?

A. I can't recall ever having seen a piece of iron pipe as a pipe used in an airplane, although I have seen numerous cases, and even recently, where pipe nipples have been used, which represent a very short length of iron pipe. Does that answer your question?

XQ. 298. That's satisfactory. Will you now, Mr. Amon, refer to your Exhibit No. 2 and tell me, does that represent the position of the parts at finger tight or after the parts have been drawn up to make a coupling?

A. The parts are at least finger tight. I'd say that they can be finger tight or that some tightening could have been put on them.

XQ. 299. It does, does it not, then, represent the [97] relationship of the parts after the recommended torque has been applied to the nut in order to tighten up the joint?

A. No; not the recommended torque or hardly even the minimum torque.

XQ. 300. With respect to the cutaway Exhibit No. 1, the physical exhibit, does that represent the parts finger tight or after the torque has been applied?

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A. From my inspection of the sample, although the parts are loose now and can be turned, I believe that there must have been some measurable torque, such as, for example, the minimum torque, applied to this fitting before this section was cut out.

XQ. 301. You mean that from your inspection, then, of that fitting, the recommended torque, the torque recommended in order to make a tight fitting, was not used?

A. Torque recommended to make it a tight fitting was not used?

XQ. 302. Yes.

A. No; I can't say that. I can't say what torque was used. It has been held in a vise. I can see the wrench marks here. The fact that the fitting is loose now doesn't have any relation to how tight it was before this section was cut out, because when you cut practically a whole half of that fitting away you destroy the strength [98] of the fitting and the parts become looser.

XQ. 303. In a case like that, then, Mr. Amon, you relieve the tension on the nose of the sleeve also, do you not, when you cut it away?

A. Yes. It's the same thing as breaking—we referred to it in that hoop tension. You break the hoop and you have no more tension.

XQ. 304. Then as we look at the cutaway sample in Exhibit 1, we do not see the parts in the relationship they have when the fitting is drawn up tight; that's true, isn't it? A. That's true.

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XQ. 305. Referring again to Exhibit 2, I believe you said that this represents the parts when they are finger tight? A. That's correct.

XQ. 306. And on the drawing Exhibit 2 there is illustrated the sleeve head angle, one degree or one and one-half degrees, whatever it is, and that sleeve head angle is plainly visible; isn't that true?

A. Yes.

XQ. 307. And you have said in cross-examination that the clearance between the butt end of the head and the inside diameter of the nut is plainly visible. What happens to the clearance at the head end of the sleeve when you draw the nut up with the recommended torque in order to make a tight joint? [99]

A. It diminishes to a degree dependent on the amount of torque applied with respect to the particular size fitting that you are talking about.

XQ. 308. It diminishes to nothing, doesn't it?

A. Not unless you get into the over-tightening range.

XQ. 309. The clearance at the butt end of the head also diminishes to nothing, doesn't it, when you tighten it up with the recommended torque?

A. Well, the recommended torque is a torque range. It has a minimum and a maximum.

XQ. 310. Let's say the average.

A. With any one clearance, for any one particular sample, into which you must take into account the manufacturing tolerances that are allowed on the sleeve head diameter and the inside

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diameter of the nut, you can't say that that clearance will diminish to nothing at any specific torque or you can't necessarily say that it will diminish to nothing within even the maximum torque for one given sample. In general, it does diminish as the torque goes up, but you can't say exactly at what torque it will reach nothing.

XQ. 311. The head or the free end of the sleeve spreads a great deal more than the butt end, doesn't it, when you tighten it up? [100]

A. It spreads more. However, neither one spreads very much, if that relates to what you mean by "a great deal."

XQ. 312. Well, it only has five one-thousandths clearance, so it can't spread any more, can it?

A. No; that is right.

XQ. 313. If you had a nut of minimum tolerance at the portion there that surrounds the head of the sleeve and if you had a sleeve of maximum tolerance, would you still have the five one-thousandths of an inch clearance which you say is represented on Plaintiff's Exhibit No. 2?

A. You will have either the five thousandths or some few thousandths less than that. I didn't check the actual clearances. It's only a matter of a few thousandths difference.

XQ. 314. Those few thousandths are enough to entirely close the clearance, aren't they?

A. Well, you can't entirely close the clearance to a matter of a half a thousandth or something like that or it wouldn't be possible to slip the nut over the sleeve.

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XQ. 315. You mean, not even if it were relieved after you separated the parts and the strain is relaxed?

A. I am speaking when I say "slip the nut over" of when you first make the assembly you put the nut on the tube and then you slip the sleeve over the end of the tube [101] and then you make a flare. When you go to draw up the fitting, the nut has to pass over the head of the sleeve in order to engage the threads on the body, and if no clearance is provided, they will not go together.

XQ. 316. Well, the clearance is there also, is it not, to let you back the nut off after you uncouple it so the sleeve will come away from the nut?

A. Yes. Well, assuming that there is enough clearance to get it on in the first place, you can get it off afterwards.

XQ. 317. Well, it's true, then, isn't it, Mr. Amon, that so long as you have a clearance in there such as you have said exists that the tension in the head will hold the sleeve against the flare to make the fitting tight?

A. As long as you have a clearance——

XQ. 318. As long as you have the clearance which you talked about, you will have a coupling when it is made up wherein the inherent resiliency of the head will press itself against the flare enough to make the fitting tight; that's true, isn't it?

A. You have used a couple of different terms there and I had to follow you very closely. That

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is true, speaking—we do have separate parts. You are still talking about this fitting, Exhibit 2 here, with a separate nut and a separate sleeve? [102]

XQ. 319. That is right.

A. And the clearance between them which permits the sleeve to expand?

XQ. 320. That is right.

A. Yes. The answer is yes to that question.

XQ. 321. Then it doesn't make any difference whether the tip end of the sleeve hits the flare first or whether the butt end hits the flare first?

A. In terms only of getting an expansion of the sleeve, as you stated, with a clearance allowed between it and the nut, you get that expansion of the sleeve whether it contacts at the very toe of the sleeve or at the base of the sleeve, that is true. You get expansion with contact at either point.

XQ. 322. Yesterday you talked about hoop tension, if I got the term correctly. Hoop like the hoop on a barrel? A. Yes.

XQ. 323. Is that the term?

A. We used that. That term was used.

XQ. 324. Will you explain that to me again? I didn't get quite clearly what you meant by hoop tension.

A. Well, your example of a hoop over a barrel is a good explanation for it. When you put a hoop on the standard wood barrel, that is, a metal hoop, the barrel has sides which curve out so that the barrel is bigger around the [103] middle than it is at the ends, and you slip the hoop over the

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smaller ends and drive it down over the expanding wood surface and you tend to spread the hoop.

XQ. 325. Well, on a barrel you have more than one hoop, don't you? A. Yes.

XQ. 326. One hoop down near the bulge and one up near the end?

A. Yes; and hoops of different sizes.

XQ. 327. Is there hoop tension on all the hoops?

A. There is hoop tension on them only if they are driven on in such a way that it takes pressure to force them over the bulged section of the barrel, or if some pressure is put on the inside of the barrel afterwards that tends to stretch the hoop. Some stretching of the hoop has to be accomplished to give you the hoop tension.

XQ. 328. On Exhibit 2, will you lay your pencil on the portion wherein there is hoop tension?

A. The hoop tension appears in the head of this sleeve. It appears in a greater degree at the end of the sleeve adjacent to where it contacts the flare, and will then appear in a lessening degree back to about the point where the sleeve shoulder engages the nut shoulder. Possibly a little further than that under some conditions of tightening at the high torque ranges or at the low torque [104] ranges it may not go any farther than that at all.

XQ. 329. Will you state again for the record what is accomplished by hoop tension? What does that do?

A. Referring again to the hoop on a barrel, and assuming that we have spread the hoop in order to

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get it to the place desired on the bulging side of this barrel, a stress has been set up in the middle of the hoop. It's in the same manner as a stress is set up in a rubber band if you stretch it. Now, the metal in the hoop isn't like the rubber in a rubber band in this sense; that it will not stretch very far before it would break, but if you only stretch it within the elastic limit of the material, it retains and holds that spring action tending to go back to its original size, and that's what we have here in this sleeve head when we speak of hoop tension. It has been enlarged by putting a pressure on in such a manner as to tend to stretch it. Although that stretching may increase the diameter of it only by a few thousandths, it tends to return to its original shape, and that gripping action is continuous.

XQ. 330. Well, didn't you tell us that it was the hoop tension that prevented the tube from pulling out of the coupling?

A. I said that that assisted in preventing the tube from pulling out of the coupling in that it has a [105] spring-like grip on the outside of the tube which it retains until the nut is loosened and the sleeve is permitted to move back to the point where it can contract again to its original size.

XQ. 331. Is that a pecularity of the three-piece fitting manufactured by Parker according to AN standards? Does it exist in the Parker manufactured fittings only?

A. It exists in any fittings when installed if the

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fittings are made to the AN Standard detailed drawings.

XQ. 332. It exists also, does it not, in the sleeve of the 811 series? A. Yes; it does.

XQ. 333. To the same degree also; right?

A. Not necessarily to exactly the same degree, because of small differences in dimensions and angles between the two. That is, for any one fitting on any one size tubing at any one torque, the degree of hoop tension in the sleeves of the two parts are not necessarily identical.

XQ. 334. Well, there is hoop tension in the butt of an NAF Standard two-piece fitting, too, isn't there?

A. Yes. The correct engineering answer to that is yes. When you pull up the NAF nut, you again bring a tapered seat in contact with a matching tapered surface under pressure which tends to bulge the nut. However, the [106] nut is a heavy-sectioned part, and the degree of expansion of such a heavy-sectioned part is not comparable with the degree of expansion of a thin-sectioned part. It would be the same as a heavy, thick hoop on your barrel or a thin hoop. The heavy hoop, you just couldn't drive it onto the barrel to the point where you could drive the thin hoop on, because the barrel would be crushed.

XQ. 335. Well, then, so far as AN fittings are concerned, or the Parker equivalent, there isn't anything new about the idea of hoop tension? That was old stuff; isn't that true?

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A. I can't say how old it is.

XQ. 336. Well, at least it wasn't new with the AN fitting?

A. It had been in the 811 fitting before that. It has always been in the Parker three-piece fitting even before it was an 811 fitting, I would say, from an engineering standpoint.

XQ. 337. The Parker 811 fitting was a good fitting, wasn't it?

A. Yes; it was a good fitting.

XQ. 338. And there was a clearance, was there not, in the 811 fitting between the outside of the head and the inside of the nut?

A. Yes; there was a clearance there in the same sense that we talked about it here on [107] Exhibit 8.

XQ. 339. And in the 811 fitting, when you made it up tight, there was still a clearance between the outside of the head and the inside of the nut; is that right?

A. Yes; there was, except that the permissible torque range was more limited. The setup in pressures on the fluid systems in airplanes, 3,000 pounds on the hydraulic systems, and even in fuel systems you are up to peak pressures of six, seven hundred pounds now on large size lines on jet propelled planes, and it's necessary to get a higher performance from the fitting than it was before those pressures came into being, so where we may have had a minimum of trouble of locking the sleeve in the nut ten years ago, we might with that same fitting

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today have definitely more trouble because it's being used at higher pressure and the torques put on them are higher.

XQ. 340. Well, with respect to a three-piece coupling of the type generally similar to the AN Standard, it isn't your contention, is it, that Parker was the first to provide a clearance between the head of the sleeve and the inside of the nut?

A. No; I wouldn't contend that.

XQ. 341. Yesterday in your direct testimony you talked about lead tubing. Was it lead tubing that you mentioned or lead pipe?

A. I think it was referred to as lead pipe. [108]

XQ. 342. If the lead pipe had a corresponding outside diameter to the tube shown in Exhibit 2 and a corresponding inside diameter to the tube shown there, you could clamp lead pipe with the same kind of a fitting that you show on Exhibit 2, couldn't you? A. That's correct.

XQ. 343. And you could make a tight joint, couldn't you?

A. You could make a tight joint for moderate pressures. I wouldn't feel that you would make a tight joint for a high pressure line with a higher torque range. You would have to use a low torque with this type of joint on lead tubing.

XQ. 344. When you want a higher pressure range, you use a tubing with a little greater tensile strength in the wall; isn't that true?

A. A little greater tensile strength or heavier wall; is that what you mean?

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XQ. 345. A little greater tensile strength in the material of the wall.

A. Yes; we do that, and also go to increased wall thicknesses.

XQ. 346. Lead is softer than copper, naturally?

A. Yes.

XQ. 347. And copper is softer than aluminum?

A. Yes. The type of aluminum tubing we refer to, [109]which is 52 SO.

XQ. 348. Especially annealed copper tubing is softer than aluminum? A. Yes.

XQ. 349. And aluminum is softer than steel?

A. Yes.

XQ. 350. So it is true, then, is it not, that you select the material of the tube in order to fit the particular requirements that you may have?

A. That is the standard design approach to putting in a piping or tubing system is first of all to get a tube or pipe that is suitable from a weight and size standpoint and strength standpoint and selection of proper fittings to go with that tubing.

XQ. 351. Yesterday you made considerable point of the fact that it is important in aircraft construction to have the fitting of such a character that you can use it in a small or limited space; that is right, isn't it?

A. Yes; that's correct, speaking particularly of what we refer to as close quarters.

XQ. 352. Well, it isn't true that the three-piece AN Standard fitting is the only one that you can use in close quarters, is it?

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A. No; you certainly couldn't say that that is the only one that can be used in close [110] quarters.

XQ. 353. Will you name some of the other ones, please, if you know them?

A. One other fitting is the original brass fitting used with small size copper tubing wherein a portion of the fitting is soldered to the tube. That fitting is on Standard Air Force drawings under the number like 805 or in the high 700 series, and it was a three-piece construction but not a flared fitting and has the advantages of being used in close quarters.

XQ. 354. Two-piece flared fittings can be used in close quarters, too, can they not?

A. The two-piece flared fitting can be used in close quarters generally if there is not a bend or a clamp or something on the tube quite close to the nut. The biggest objection to the two-piece type fitting in close quarters is the nut does not slide back around the bends, whereas the nut on the three-piece fitting has greater clearance from the tubing and will slide around bends.

XQ. 355. Two-piece flared fittings have been known for at least 35 years, haven't they?

A. Two-piece flared fittings?

XQ. 356. Yes.

A. I'd say that they must have been known for at least 35 years.

XQ. 357. There isn't anything new, then, to the use of [111] tubing lines for economy of space?

(Deposition of Frederick E. Amon, Jr.)

A. Well, I will have to answer that question by saying that there is nothing new in the use of tubing lines with which you get economy of space, but the idea of using tubing lines for economy of space on high-pressure systems and large size lines is relatively new compared to the total use of tubing. For example, in steam power plants today they use tubing up to six and eight-inch sizes for economy of space and better flow character and greater strength, but it's all welded construction. It isn't the same type of problem we have with the use of the flared fitting.

XQ. 358. It doesn't have anything to do, then, with the introduction of the Parker three-piece fitting; that is right, isn't it?

A. The lines of six and eight-inch sizes, it doesn't. However, high-pressure lines do. As I pointed out, the Parker fitting was the earliest fitting used widely on hydraulic systems in the machine tool field, as a typical example, where we speak of hydraulic pressures of 500 pounds and up and line sizes running from 1/8 of an inch to a maximum of about two inches.

XQ. 359. Among other things that you mentioned in your direct testimony was the ease of disassembly and reassembly of three-piece fittings, for example. The fitting [112] that Parker manufactures is more or less easy to disassemble and reassemble; that is correct, isn't it?

A. Yes. Speaking of close quarters work again; is that what you are referring to?

(Deposition of Frederick E. Amon, Jr.)

XQ. 360. Anywhere.

A. Yes. The answer is yes.

XQ. 361. Do the particular angles which Parker has selected for his three-piece fitting have anything to do with the ease of assembly and re-assembly?

A. Yes; they do. The angle on the flare and the length of the flare determines the distance that the tubing must be moved back away from the fitting before it can be slipped off to one side for removal. If you had a 90 degree angle on the end of the flare, which would mean that it was flared out square with the end of the tube or at an abrupt right-angle turn, you would have the ideal condition simply for ease of disassembly. It would be then necessary to loosen the nut only and get it back out of the way and the tube could be slipped off to the side with a very minimum of movement of the tube away from the fitting. On the other hand, if you went down to a ten-degree angle on the nose of the fitting, you would have the tip of the flare extending further back along the fitting, which would mean it would have to be moved away some additional distance before it could be slipped free of the tube; [113] slipped free to one side from the fitting, that is.

XQ. 362. Well, Parker didn't select the angles that you are talking about, did he?

A. Parker didn't specifically select the angles shown on this Exhibit 2 as a 33 degree angle on

(Deposition of Frederick E. Amon, Jr.)

the nose of the fitting for a series of fittings. Is that the answer you want?

XQ. 363. Yes. Somebody else selected that, didn't they?

A. Yes; that specific angle was selected when these fittings were designed, when the detailed drawings were made.

XQ. 364. And that fitting can be easily disassembled and re-assembled, can it not?

A. It's easy only compared to something else. It is still not the ideal. At the present time, particularly for use on large size lines—and I am speaking of lines up to three and four-inch sizes for some of these big airplanes—it would be desirable to have a fitting that would separate on a straight-across cleavage line, which this fitting doesn't do. It does require some movement away.

XQ. 365. You made some explanation here yesterday about the disadvantages of vapor lock in a gasoline line. Is it your contention that the use of Parker fittings is especially advantageous in eliminating vapor lock? [114]

A. The use of Parker fittings is advantageous in eliminating vapor lock, but only in this sense: This fitting has a flow passage through it that is as nearly as large as the inside diameter of the tubing as is practical to make it, and with fittings of this type, in which each joint is a union and the tubing sections can be taken apart easily, it is convenient in airplanes to use many tube bends. That is the

(Deposition of Frederick E. Amon, Jr.)
ideal situation in the sense of eliminating or preventing vapor lock, to use a tubing system with a minimum pressure drop. The tubing itself is the primary factor controlling the pressure drop; that is, the length of it, the size, the number of bends, compared to the flow rates. The fittings should add only the minimum additional pressure drop necessary.

XQ. 366. Parker fittings are not the only ones that fit that requirement, are they?

A. No; that is correct. Other fittings fit that requirement, if no more of them is required and if they have equivalent flow passages.

XQ. 367. You are familiar, are you not, with the flaring of tubing with a flaring tool?

A. Yes, sir.

XQ. 368. That is the way the flares on the tubing are made on the exhibits which you have produced here, is it not? [115]

A. Yes; these flares are made on a flaring tool.

XQ. 369. You know what a split flaring die is?

A. Yes.

XQ. 370. And what do you call the pin that goes into the die? The flaring pin?

A. Flaring pin.

XQ. 371. Suppose you had a flaring pin with a hole and at the end of the hole an angular spread, which determines the form of the flare of 33 degrees, and suppose you clamped a piece of tubing in that and flared it with a flaring pin, what would be the

(Deposition of Frederick E. Amon, Jr.)
angular degree of flare on the outside of the tubing after you got it out of the flaring die?

A. Now, the question is: What would be the angle on the outside of the flare when you would take it out of the flaring die?

XQ. 372. Would it be 33 degrees or would it be less?

A. It would be 33 degrees if it were soft tubing that didn't have any spring-back, and if the mating angle on the flaring pin were such that it spread the inside of the flare to a greater than a 33 degree angle.

XQ. 373. Suppose it is aluminum tubing?

A. Soft aluminum tubing?

XQ. 374. Like you use in airplanes?

A. It would be very close to 33 degrees.

XQ. 375. Suppose it was copper tubing? [116]

A. It would be very close to 33 degrees on soft copper tubing.

XQ. 376. Suppose it was hard copper tubing?

A. Then you would have spring-back.

XQ. 377. Suppose it were steel tubing?

A. Then you would have spring-back, too, depending on the alloy. The spring-back is a matter of possibly only a very small part of a degree or, in other words, a small amount.

XQ. 378. You mean, less than a degree?

A. Normally, less than a degree on the type of tubing that we are talking about here, the type of flaring tools that are used, but I can't say that it would not be in excess of a degree.

(Deposition of Frederick E. Amon, Jr.)

XQ. 379. Well, on the Parker tool which is designed to flare tubing for the AN specifications, what is the angular degree of divergence in the hole in the flaring die?

A. It's very nearly 33 degrees. I can't say positively that it's exactly 33 degrees. Some tolerance is allowed for manufacturing purposes.

XQ. 380. What is the degree on the end of the flaring pin? What is the number of degrees in the angle?

A. Well, that's approximately 33 degrees again. I can't say that it is exactly that, but it's in that neighborhood, within a degree or two at least. [117]

XQ. 381. Don't you mean 37 degrees?

A. Pardon me. You are correct. 37 degrees is correct.

XQ. 382. I want to refer you, Mr. Amon, to a Parker catalogue, and particularly Page 13, which I show you, at the bottom of the page. There it made reference to a triple hammer type flaring tool, and that tool is described as a piece which screws into the nut of the coupling and a hammer is driven into the tube in order to flare the tubing. When you flare tubing with a tool of that kind it is true, is it not, according to your explanation, that the outside diameter of the flare on the tubing after the flare is completed lays in substantially face-to-face contact with the inside of the flare of the sleeve?

Mr. Freeman: Will you identify the catalogue

(Deposition of Frederick E. Amon, Jr.)

by either catalogue number or year number so that it may be of record?

Mr. Beehler: Yes. Identified as "Parker Tube Couplings for Industrial Use. Price List No. 202-C."

Mr. Freeman: Is there any date on the catalogue?

The Witness: It was printed in June of 1946, 50,000, I believe.

Mr. Beehler: Do we have the last question [118] answered?

(Question read.)

A. Yes; it would be substantially in contact with the inside of the sleeve.

XQ. 383. That is, almost but not quite, due to some resiliency in the metal of the tube?

A. No; not with that type of flaring tool. It would depend on where the mechanics stopped. Now, the way you will tell whether you have a good flare or not with that type of tool is to hammer it to an amount that you learn only by experience and then remove the tool and slip the nut down so that you can inspect the relationship of the flare with the sleeve, and by inspection of that assembly there you can tell if the flare is long enough and if it has been spread to a great enough angle.

XQ. 384. That flaring tool is recommended by The Parker Appliance Company, is it not, as a good tool?

A. It's recommended by The Parker Appliance

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Company only where better tools can't be used. It is not the desirable flaring tool to be used, but it is possible with a tool like that to make a flare on a tubing line sometimes even without taking it free from its connection at the other end, and its use is quite limited.

XQ. 385. Is the Parker flaring tool represented on Page 15 of the same catalogue, tool No. 281, a better tool than the [119] first one referred to?

A. Yes; it is better, although it can only be used with the Parker inverted flare two-piece coupling that preceded the three-piece coupling. It's better particularly in that there is an inspection window on the side of the tool that permits you to see the degree of flaring accomplished on the tube without removing the tool from the line.

XQ. 386. Well, I suppose you mean, then, that the Parker tool illustrated on Page 14 as tool No. 2343 is still a better flaring tool; is that right?

A. Yes; 2343 is a better tool, but that tool is used only on very small sizes, that is, for 1/8 and 3/16 inch O.D. tubing, and for those sizes of tubing it is good, I would say, to use the one in Figure 283.

XQ. 387. Well, what would you say, then, with reference to the Parker tool No. 410 illustrated on Page 14 of the same catalogue?

A. That tool, 410, is a better general tool for flaring than either of the previous tools, although it is not necessarily particularly better with respect to individual flares than Figure 2343.

(Deposition of Frederick E. Amon, Jr.)

XQ. 388. Well, it is true, is it not, that whether you have a good fitting, a good joint, made up with one of these AN fittings or a bad one depends to a degree on what [120] kind of a flaring tool you use?

A. I can't say that, because a good mechanic can give you a good flare with even a poor tool and maybe not even a better flare with what I say here is a better tool.

XQ. 389. Well, then, you say, do you not, that whether you have a good or a bad joint with one of these fittings depends on the skill of the mechanic; is that correct?

A. The skill and training of the mechanic. You must have a good flare or you cannot be assured of a good joint.

XQ. 390. And that is true no matter how you make the fitting, isn't that so?

A. That's desired no matter how you make the fitting. You have to have a good flare to start with.

XQ. 391. There is no such thing as a foolproof fitting; correct?

A. Unfortunately, there isn't.

(Discussion, off the record.)

(Recess.)

Mr. Beehler: I want to offer in evidence as Defendants' Exhibit A, Cleveland Deposition, the Parker Catalogue identified as "Price List No. 202-C, B16C-646," and particularly Pages 13, 14 and 15 thereof.

(Deposition of Frederick E. Amon, Jr.)

Mr. Van Sciver: No objection, except as [121] to materiality.

(Parker Catalogue marked, "Defendants' Exhibit A (Cleveland Deposition)".)

XQ. 392. Referring again, Mr. Amon, to Plaintiff's Exhibit 2, for example, and having particular reference to the portions which you have labelled "sleeve shoulder" and "nut shoulder," is it advisable that those two shoulders be in a plane transverse to the axis of the coupling? A. Yes.

XQ. 393. Is it less advantageous if the angle of the nut shoulder is tilted with respect to the angle of the sleeve shoulder in a direction such as that the surface of the nut shoulder hits on the outer portion of the sleeve shoulder?

A. Yes; any change of those angles that would tend to give you point contact would be less desirable than a surface contact, because it would increase the bearing pressure. However, if any point or line contact does occur, it's very desirable to have such contact at the largest diameter on the sleeve head rather than at the smallest.

XQ. 394. Just a little while ago we talked about making a flare on tubing with a flaring tool, wherein we used the sleeve and the nut and screw into the flaring tool part and then drive the pin home, and we said, as I recall, that when a flare is made that way with copper tubing or aluminum tubing that the metal of the flare will spring [122] back a little bit away from the flared inside portion of the sleeve; is that correct?

(Deposition of Frederick E. Amon, Jr.)

A. We spoke of spring-back, but with that type of flaring tool that you describe it isn't necessary that that outside diameter of the flare strike the sleeve inside surface when the flare is made. The important thing is that the pin on the flaring tool be forced into the inside of the flare to spread it to the proper angle and the proper length of flare.

XQ. 395. Well, if the pin is not driven too hard, then, if, let us say, it's a good flare and the metal of the flare does not spread out far enough to be actually driven against the inside surface of the sleeve, then there will be a little space, will there not, between the outside surface of the flare and the inside surface of the flared part of the sleeve?

A. That would be true, although that is not a good flare. I believe you were speaking of a good flare.

XQ. 396. In a good flare, what would it be?

A. In a good flare, by inspection, as I mentioned, you take the tool out and slip the nut down on the tube away from the sleeve and the flare portion. Then you look at the flare with respect to the end of the sleeve and check both the diameter of the flare with respect to the outside diameter of the sleeve head and you also check to [123] see that you have the flare spread far enough that your sleeve is in contact with the flare at the point where you can see it. That's the standard way.

XQ. 397. Well, what point would have the contact? It would be at the base of the flare, wouldn't it?

(Deposition of Frederick E. Amon, Jr.)

A. Well, speaking of very small angular differences on small fittings which are hard to see, it would be impossible to actually say whether the contact was at the base of the flare or at the tip, even if you hold it up and look at it.

XQ. 398. Well, how about a larger one where you could see?

A. It would be a little easier to see on the larger one, but there again the size, the length of the flare, does not increase as the diameter of the tube does, so you couldn't see things in the nature of a half a degree difference there either way.

XQ. 399. Well, you would end up with a slight clearance, would you not, between the outside surface of the flare, flared part of the tube, and the inside surface of the sleeve angle near the outer end?

A. Well, it would be unusual if you had exact contact at both the heel and the toe under no pressure, meaning that the two surfaces were exactly parallel, so you will in most cases have initial contact at the base of [124] the flare or at the outer end of the flare, but if the flare is acceptable, that difference will be very small. That's what I was trying to bring out.

XQ. 400. Well, fine. If we had the contact at the base of the flare, under the circumstances which you mentioned, and if we then draw up the nut against the sleeve head in order to couple up the joint, we do not get an initial contact near the nose of the sleeve; that is right, isn't it?

(Deposition of Frederick E. Amon, Jr.)

A. That is correct. Not necessarily. You do not necessarily get that initial contact at the toe; that is right.

XQ. 401. Then as we continue to draw it up, we bend the material of the sleeve inwardly toward the flare; isn't that right?

A. You bend the material of the sleeve inwardly?

XQ. 402. Of the sleeve head.

A. Inwardly?

XQ. 403. Inwardly toward the flare.

A. The flare?

XQ. 404. That's true, isn't it?

A. Not with soft tubing, which is what we are speaking of, isn't it? You don't get that.

XQ. 405. Well, copper tubing.

A. You don't get that action with copper tubing in that fitting. [125]

XQ. 406. What action do you get?

A. Any difference between the angles of the inside and outside of the flare with respect to the angles of the fitting nose and the inside of the sleeve will be brought into adjustment on copper tubing in the very early part of the tightening, the copper being soft, before there is sufficient stress imposed on the parts to create any measurable change in the dimensions or diameters of the sleeve.

XQ. 407. Well, in any event, you don't get a digging in of the nose of the sleeve into the flare, do you?

(Deposition of Frederick E. Amon, Jr.)

A. You don't get that in the initial portion of the tightening. That happens in the second portion of the tightening when you start to go to a higher torque, at which point the stress gets high enough that the sleeve head is deformed, too, starts to deform.

XQ. 408. Well, if the sleeve head rides up on the outside of the flare, then it spreads, doesn't it?

A. That is correct. The sleeve riding on the outside of the flare tends to spread; that is right.

XQ. 409. And it's that riding up of the sleeve on the flare which closes the contact between the adjacent surfaces; isn't that true?

A. Yes; it's the expansion of the sleeve that closes that contact. [126]

XQ. 410. And isn't the objective on all of these coupling joints to get a maximum amount of contact between flat engaging surfaces of the conical portions of the fitting?

A. Speaking of the fitting, you say conical——

XQ. 411. Conical portions of the flare of the sleeve and the body.

A. On soft tubing; that is right. That isn't so critical on the hard tubing, but on soft tubing it is important. Does that answer your question?

XQ. 412. Yes.

Mr. Freeman: I wonder if you will let the record show that you have been pointing out——

(Deposition of Frederick E. Amon, Jr.)

Mr. Beehler: I have been pointing out parts of Plaintiff's Exhibit 2.

Mr. Freeman: 2 as distinguished from Plaintiff's Exhibit 8.

Mr. Beehler: Thank you.

XQ. 413. Yesterday, Mr. Amon, you introduced as Plaintiff's Exhibit 4 a group of drawings, and I refer you to one of those drawings, namely, the one entitled "AND10059, Sheet 2," wherein there are depicted numerous bodies bearing various names, such as tees, unions, elbows, and the like, which show conical portions on the body adjacent to threads against which a tube is adapted to fit. That is correct, [127] isn't it?

A. That is correct.

XQ. 414. Is it not true, Mr. Amon, that those bodies can all be closed with either the nut captioned "AN818," which is the nut for the triple fitting, and the nut captioned "AN817," which is the nut for the two-piece fitting?

A. That is correct.

XQ. 415. The bodies are interchangeable with respect to those two different types of nuts?

A. That is correct.

XQ. 416. So that the bodies can be used either with the three-piece tubing or a two-pice tubing?

A. Fitting.

XQ. 417. Thank you. Three-piece fitting or a two-piece fitting?

A. That is correct.

(Deposition of Frederick E. Amon, Jr.)

Mr. Van Sciver: AN817 is not one of this group; is that correct?

The Witness: The center one at the top. Oh, not one of the detail sheets; no.

Mr. Van Sciver: It is the third one from the left at the top of the AND10059, Sheet 2.

XQ. 418. You spoke yesterday, Mr. Amon, of having worked with—well, I guess I don't recall the name of the Government agency, but the Board which was directed to the [128] standardization of these fittings. What was the name of that Board?

A. I referred to it as the Aeronautical Board.

XQ. 419. Were you a member of the Board or were you a commercial adviser, a manufacturer's adviser?

A. I was not a member of the Board. I contacted them as a sales representative of The Parker Appliance Company.

XQ. 420. You were not the only manufacturer's sales representative working with the Board; is that right?

A. No; I was not the only one.

XQ. 421. How many others were there, do you know?

A. Well, I obviously don't know how many there were but there must have been several.

XQ. 422. Could you name some of them? The manufacturer, if you will name it, it will be sufficient. A. The Weatherhead Company.

XQ. 423. Aeroquip, did they have a man there?

A. Well, Aeroquip was in contact with them,

(Deposition of Frederick E. Amon, Jr.)

but probably on other phases or other specifications, at the same time. They were conducting or carrying on work on a number of specifications at one time, so there were really a number of people contacting them on various subjects.

XQ. 424. With respect to the fittings, did Mr. Masters happen to be in contact with them at that time?

A. I presume that he must have. He was in the industry [129] at that time. It would be unusual if he weren't.

XQ. 425. It's true, is it not, that the Aircraft Board continually circularized the manufacturers for recommendations with respect to fittings?

A. With respect to these fittings in connection with the standardization program on these fittings?

XQ. 426. Yes.

A. No; I believe the answer to that is no.

XQ. 427. They did not circularize the manufacturers?

A. That was done prior to the establishment of the procedure that's in effect today for coordination of proposed specifications with the industry under the A.I.A.A. I'd say that that was not an organized program at that time, and although the representatives on the Aeronautical Board did write letters several times to Parker on phases of this subject, and I presume they probably did to others, I don't believe we could say that there was a wide coordination at that time.

(Deposition of Frederick E. Amon, Jr.)

XQ. 428. You are familiar with the S.A.E. A-3 Committee which works on standardization; are you?

A. Yes; I was a member of it at one time.

XQ. 429. And did they not circularize the manufacturers regularly for recommendations?

A. I can't say no, obviously, but I don't think it was done to any great extent. It certainly was not done [130] to the extent it is done under the present A-3 Committee.

XQ. 430. In any event, they sought the advice of manufacturers in setting up their standards?

A. Yes. You speak of manufacturers of fittings?

XQ. 431. Yes.

A. Well, that's true, members of A-3 are in a large part from the fittings and hose manufacturing companies.

XQ. 432. And there were many others there besides The Parker Company, isn't that true?

A. You refer to the meetings that they——

XQ. 433. Many other manufacturers in connection with this committee other than Parker?

A. No; there were only a few companies on the committee. There are only a few companies represented on it today, but today they do what I feel to be a thorough job of coordinating their work with other manufacturers not represented on the committee.

XQ. 434. Yesterday you mentioned your Exhibit No. 7 as having been painted black. It's true, isn't

(Deposition of Frederick E. Amon, Jr.)
it, that the specifications call for steel fittings all to be painted black, not only Parker fittings?

A. That is correct. The same is true of the blue on the other exhibits. I said that it was manufactured by Parker because it has this Parker name or a symbol on it, [131] and being black identifies it as an AN fitting.

XQ. 435. Yesterday you talked about wire-locking fittings. Do you know of any flared type fittings which were wire-locked when used on aircraft construction at any time?

A. Flared type? No; I don't know of any flared type fitting that is in use, at least in this country. I can't speak for what may be done in aircraft in other countries.

XQ. 436. Well, confining yourself to this country's practices, then, wire-locking flared type fittings for aircraft construction is a rather extraordinary procedure, isn't it? A. Yes.

XQ. 437. And you spoke of the peculiarities of the Parker fitting as being such that they did not require wire-locking, did you not?

A. That is right.

XQ. 438. Then there isn't anything different in that respect about the Parker fitting than there is about other flared type aircraft fittings?

A. Well, I can only answer that question specifically by referring to other current aircraft fittings.

XQ. 439. I will be glad to confine my question to that.

(Deposition of Frederick E. Amon, Jr.)

A. There is only one other flared fitting which I know to be in common use in aircraft today, which is the AN817 [132] nut in connection with the bodies referred to here on this exhibit a moment ago.

XQ. 440. That's a two-piece fitting, is it not?

A. A two-piece fitting. And where those are used, they are not wire-locked, to my knowledge. I know of no other flared fittings that are being used.

XQ. 441. No flared fittings other than the AN Standard; is that it?

A. In any appreciable quantity. There are some of the NAF Series still on service airplanes, and there are some of the previous Air Force 811 Series, and even some of the Air Force Series 810, which was a two-piece fitting of an entirely different construction than the NAF Series but which preceded the AC811 fitting.

XQ. 442. Were the AC811 fittings ever wire-locked for aircraft use?

A. Not to my knowledge.

XQ. 443. There was another series of fittings for aircraft construction, was there not, called the BU Aero 5945. Are you familiar with that?

A. Yes; I remember that series.

XQ. 444. That was a three-piece or two-piece?

A. That was a two-piece, made in small sizes only. It was in use before I was familiar with these problems.

Mr. Beehler: No further questions. [133]

(Deposition of Frederick E. Amon, Jr.)

Redirect Examination

By Mr. Van Sciver:

Q. 445. Mr. Amon, referring to Exhibit 8, did Parker originate the differential angle shown in that drawing?

A. Yes; Parker originated the differential angle as referred to on this drawing. I pointed out before, there is a double angle on here and also a differential angle, which is a different thing. Parker did not originate the double angle but did on the differential angle.

Q. 446. There was mentioned a figure of five thousandths of an inch as being the nominal clearance between the base of the sleeve and the nut. Is that the diametric clearance?

A. Yes; that is the basic difference between the diameters of the two parts.

Q. 447. What is the actual distance between one side of the base of the nut and the sleeve?

A. With the sleeve in the center of the nut, the clearance on one side between one side of the sleeve and the adjacent nut would be half of that clearance, or two and one-half thousandths.

Mr. Van Sciver: That is all. [134]

Recross-Examination

By Mr. Beehler:

XQ. 448. Referring again to Plaintiff's Exhibit 8, that's a rather large blowup, is it not, of the actual fitting?

(Deposition of Frederick E. Amon, Jr.)

A. Yes; it must be. It's obviously one of the small size fittings and it's quite a blowup.

XQ. 449. So that five one-thousandths of an inch on the fitting would be illustrated on that drawing a great deal more than five one-thousandths; isn't that true? A. Yes.

XQ. 450. You just talked about the difference between a differential angle and a double angle. What is the difference? I don't understand that myself.

A. The double angle referred to represents two angles on the sleeve, one of 33 degrees and one of 18½ degrees. You asked me if Parker originated the double angle on the sleeve and I said no. That refers to the two angles on the sleeve only. The differential angle is the difference between the angle on the sleeve and the angle on the flare. So the 18½ degrees is the differential angle in that it is a different angle than the 33 degrees on the outside of the flare.

XQ. 451. Well, to further help me with respect to Plaintiff's Exhibit 8, what is the number of degrees of [135] the differential angle?

A. I speak of the differential angle as the 18½ degree angle. The number of degrees of the differential is the difference between 18½ and 33, 14½ degrees actual differential.

XQ. 452. Well, then your answer to the question on redirect examination is, as I get it—you can correct me if I am wrong—that Parker was the originator of the use of an angle of 14½ degrees?

(Deposition of Frederick E. Amon, Jr.)

A. No; I said that Parker was the originator of that kind of differential angle between an angle on the sleeve and an angle on the flare. I didn't mean to imply that they originated the specific 14½ degrees of differential. The differential might be a greater or lesser number of degrees.

XQ. 453. I am afraid, Mr. Amon, I will have to leave myself in confusion. I can't follow you as to the difference between a double angle and a differential angle.

Mr. Freeman: Do you want us to concede that you are confused?

Mr. Beehler: I'd be glad to have it further explained. I think it might help the Court.

A. It's obvious that I chose an unfortunate name here when I said "double differential angle" and drew a [136] double arrow to two points. To clear this up further, if you will visualize this as talking about two things at the same time which, unfortunately, it is, you have a double angle, which is comprised of two different angles on one part——

Mr. Freeman: Why don't you tell us what that part is so that the record will be clear and so that the Court will understand it, and so that Mr. Beehler will understand?

A. (Continuing): Those two angles are the two angles on the inside seating portion of the sleeve head, which are marked on this drawing as "33 degrees" and "18½ degrees." Those two angles, since there are two of them, are referred to here as a double angle. That term was used by me be-

(Deposition of Frederick E. Amon, Jr.)
cause this type sleeve, as shown on Exhibit 8, is known in the industry as a double angle sleeve or as a wedge-type sleeve or as a modified sleeve.

XQ. 454. Was that originated by Parker before or after March 2, 1938?

A. Well, I said previously that Parker did not originate the double angle.

XQ. 455. Well, the differential angle, then.

A. Now, the differential angle refers to an angle between angles on two different parts, as contrasted to the other, which was the two angles on the same part. [137]

XQ. 456. Just maybe to cut it short, was that which you last mentioned originated by Parker? It was, you say? A. Yes.

XQ. 457. And was that originated by Parker before or after March 2, 1938?

A. I can't answer that question specifically with respect to that close a date here in this room today.

XQ. 458. Well, actually, that was originated in 1940, wasn't it?

A. Oh, it was much earlier than 1940, because these parts had been in use and in production with such a differential angle prior to 1940 on the AC811 fitting. Now, I don't know exactly when it was prior to 1940.

XQ. 459. All right, that's all right.

A. But even before 1939, but I can't say whether it was before or after a certain date in 1938.

Mr. Beehler: That is all. Thank you.

(Deposition of Frederick E. Amon, Jr.)

Mr. Freeman: Now, just off the record.

(Discussion, off the record.)

Mr. Freeman: Mr. Amon, will you waive your signature to the deposition, to which waiver, I understand, Mr. Beehler, counsel for the defendants, is agreeable?

The Witness: Yes.

Mr. Freeman: So that it's agreed that [138] the signature may be waived; correct, Mr. Beehler?

Mr. Beehler: That's agreeable.

Mr. Freeman: Thank you. That is all.

(Signature waived.) [139]

ROBERT HENRY DAVIES

of lawful age, called as a witness on behalf of the Plaintiff, as provided by the Rules of Civil Procedure for the District Courts of the United States, being first duly sworn, as hereinafter certified, deposed and said as follows:

Direct Examination

By Mr. Freeman:

Q. 1. Will you please state your name?

A. Robert Henry Davies.

Q. 2. And where do you live? A. Aurora.

Q. 3. By whom are you employed?

A. Parker Appliance Company.

Q. 4. How long have you been with The Parker Appliance Company?

A. Since October, 1939.

(Deposition of Robert Henry Davies.)

Q. 5. In what capacity did you enter the employ of The Parker Appliance Company?

A. As a sales engineer.

Q. 6. And what is your present position?

A. Chief Engineer.

Q. 7. And how long have you been Chief Engineer of The Parker Appliance Company?

A. Three years. [140]

Q. 8. And immediately preceding the time when you became Chief Engineer, what was your position with the plaintiff here?

A. Technical Assistant to the General Sales Manager.

Q. 9. Prior to your employment by the Parker Company, what were you doing?

A. Prior to my employment by the Parker Company, I was Chief Engineer of the O. W. Randolph Company in Toledo.

Q. 10. What was the nature of their business?

A. They made drying equipment.

Q. 11. And what schooling have you had? Are you a graduate of any college or school?

A. I am a graduate of the United States Naval Academy with a Bachelor of Science degree.

Q. 12. And when did you receive that degree?

A. In 1934.

Q. 13. Are you familiar with three-piece tube couplings? A. Yes.

Q. 14. Sometimes called fittings?

A. Yes.

Q. 15. And what have you had to do, if any-

(Deposition of Robert Henry Davies.)
thing, with the sale or engineering or use of three-piece couplings as manufactured and sold by The Parker Appliance Company?

A. Well, in all the time that I have been with The [141] Parker Appliance Company, a good percentage of my time has been spent doing just that, either selling, or as an application engineer, or in actual design and testing, or at least supervision of design and testing of three-piece fittings.

Q. 16. As an application engineer and as chief engineer of the company, have you had occasion to observe the actual use of three-piece fittings in actual installations? A. Yes; I have.

Q. 17. You were present during the taking of the testimony of Mr. Amon and you have heard mention of the AN fitting; is that correct?

A. Yes.

Q. 18. Do you have here any exemplification of the AN fitting or fittings as made by The Parker Appliance Company? A. You mean, this?

Q. 19. Any physical fitting or drawing.

A. Yes; here is a fitting here, there is a fitting here, and a couple of drawings over here.

Q. 20. In other words, when you said there was a fitting here, you were first referring to Amon Deposition Exhibit 1; correct?

A. That is right.

Q. 21. And then you referred later to Amon Deposition Exhibit 7; correct? [142]

A. Yes.

Q. 22. And when you referred to two drawings,

(Deposition of Robert Henry Davies.)

you were referring to Amon Deposition Exhibits 2 and 8? A. Yes; I was.

Q. 23. Did you have any contact with the Army and Navy concerning the development of the fittings exemplified by Deposition Exhibit 1?

A. Yes; I did. After the war production got going pretty much, I worked for Mr. Amon at that time, and he became more involved with the matter of production and allocation and scheduling, and so forth, than he was with the technical aspects of this, and I more or less took over the liaison with the Aero Board and the technical contacts with the Air Force and the Bureau of Aeronautics.

Q. 24. You have heard reference to the AC811 fitting; correct? A. Yes.

Q. 25. And did that precede the AN flared fitting of the kind here involved, Deposition Exhibit 1? A. Yes; it did.

Q. 26. And it is my understanding—and correct me if I am incorrect—that the AC811 fitting was a Parker type adopted as standard by the Government?

A. It was a Parker design adopted as a standard by the Air Force. [143]

Q. 27. And, again, the "AC" indicated "Air Corps" or "Air Force"?

A. Correct. It used to be the Air Corps. It is now the Air Force.

Q. 28. Will you tell me, as briefly as you can, what transpired or what took place with respect to

(Deposition of Robert Henry Davies.)

changing from the AC811 as standard and adopting what we now call the AN fitting?

A. Well, we, of course, at that time were in pretty much volume production on the AC811 fitting, because practically every airplane except a few Navy planes were using it, and I guess even some Navy planes were using it, although it was an Air Corps Standard. So we wanted the Aero Board and the Air Force also wanted the Aero Board to accept the AC811 fitting as it was without any changes as an AN Standard. It would have simplified the manufacture, and so forth, particularly at that particular time when manufacturing was a problem. However, the Navy, I believe, was not in favor of that at that time. I don't know why. But, as a result, the present AN fitting was arrived at in an attempt to take as many of the desirable features of the 811 fitting and incorporate them into the AN fitting.

Q. 29. And in the AC811 fitting, it provided on the outer surface of the sleeve an angle; is that correct? [144] A. That is right.

Q. 30. And that was carried over into the AN fitting? A. That is right.

Q. 31. We have used the term "Army and Navy" or "AN," and I am going to ask you whether or not The Parker Appliance Company in fact sells fittings to others besides the Army and Navy?

A. Yes; they do.

Q. 32. And will you give us a list of some of the customers to whom sales are made of AN fittings?

(Deposition of Robert Henry Davies.)

A. Well, all the air lines, and also on some of the private planes like the Beech Bonanza and the Republic Sea-Bee, and so forth, those had AN fittings on them.

Q. 33. Can you give me some of the applications or uses to which your fittings are put in connection with the airplane industry?

A. Yes; the fittings are used in the hydraulic system; they are used in the air conditioning and the heating and ventilating system; they are used in the pneumatic system for controlling the bomb bay doors, for instance, on the B-29; they are used in some of the older vacuum-operated instrument systems; they are used in the fuel system, the lubricating oil system, and anti-icing system, and there are probably a few others that I can't think of right now. [145]

Q. 34. Are there many fittings actually used in the aviation industry on planes?

A. Yes; there is getting to be a lot of them. It seems that there is getting to be more and more. The more complex and larger the planes get, the more fittings are used.

Q. 35. You mentioned the use in the hydraulic systems of airplanes, and by that do you mean where the landing gear is hydraulically controlled or hydraulically operated?

A. Where it's hydraulically operated.

Q. 36. In other words, there is some power mechanism for transmitting power in a remote position?

(Deposition of Robert Henry Davies.)

A. That is right. Not only landing gears but wing flaps and cowl flaps and a lot of other places.

Q. 37. Usually the control mechanism, however, is under the control of the pilot?

A. That is right.

Q. 38. And the work is being done at a remote place? A. That is right.

Q. 39. And it is necessary to have piping to carry the control of the work to the work to be done? A. That is right.

Q. 40. And is it that type of equipment wherein tubing is used for transmitting the power from the place where it is brought about to the place where the work is to be [146] done? A. Yes.

Q. 41. What type of tubing is usually used for conveying the hydraulic fluid or any of the operating structures for transmitting work from one place to work to be done at a remote place?

A. Well, the majority of the 1,500 pound systems use 52 U. S. Aluminum tubing. There was one, a B-26 installation, that used 24 S. T. and then most of the 3,000 pound systems used dead soft annealed steel tubing.

Q. 42. Now, you are giving me the characteritics of the tubing as to material? A. Yes.

Q. 43. Is that sometimes called seamless tubing?

A. Yes. If it's not welded, it's called seamless tubing.

Q. 44. Do you have any idea or can you give me an estimate of the number of fittings of the

(Deposition of Robert Henry Davies.)

Parker type that are used on some commercial planes or some Army planes or Navy planes?

A. I couldn't give you anything except a guess.

Q. 45. Well, I am asking for an estimate.

A. O. K. Oh, I'd say there is probably five or six thousand fittings on a large commercial transport or a medium bomber, fewer on a fighter plane, and probably more [147] on some of the bigger models.

Q. 46. And is it true that it is sometimes said that there are just miles of tubing used on an airplane?

A. I have heard that were 5,000 feet of tubing on a B-17. I don't know whether that's true or not.

Q. 47. And that's cut up into short lengths?

A. That is right.

Q. 48. And that brings about the use and necessity of a flared tube coupling at each end?

A. That is right.

Q. 49. You mentioned 1,500 pounds pressure per square inch. What is the usual pressure used for controlling mechanisms on planes wherein Parker AN fittings are employed?

A. Well, the majority of planes today in operation have 1,500-pound systems. The majority, if not all, of the planes that are being designed or that are being built experimentally have 3,000-pound systems.

Q. 50. And does the problem of making a fluid-tight or pressure-tight joint change when you go

(Deposition of Robert Henry Davies.)
from a 1,500-pound per square inch installation to a 3,000-pound per square inch installation?

A. Well, it just gets tougher to do.

Q. 51. When you say "tougher to do," is there any direct relationship between 1,500 and 3,000 to the requirement of [148] the fitting?

A. Well, of course, the fitting has to be stronger with the additional pressure and it has to handle a slightly heavier walled tubing, and, of course, in going from 1,500 to 3,000 you usually go from a soft aluminum tube to a soft steel tube, which is a change, of course, and if you go to a steel tubing, you usually go from an aluminum fitting to a steel fitting, too.

Q. 52. Does the problem increase as to making a fluid-tight joint by use of a Parker type fitting when you operate under higher pressures?

A. Yes; it does.

Q. 53. Is there any advantage in using seamless tubing as distinguished from types connected together by normal type joints? A. Yes.

Q. 54. Just what is that? Just briefly for the record.

A. It's a considerable weight saving, and, of course, a flared tube fitting will stand up considerably longer, has a greater fatigue stress against vibration than a tapered type installation would have. And there is also the question of the inside bore of the seamless tubing being much smoother than the inside of other types, so you get a much better friction factor between the fluid and there-

(Deposition of Robert Henry Davies.)
fore a less pressure drop which would, of course, result [149] in power saving and less heat loss.

Q. 55. Is that power saving an important factor in connection with aviation?

A. Yes; it's a very important factor in connection with aviation, because you might, if you had a high pressure drop, have to have, let's say, the next larger size pump in order to supply the power. The power that the pump puts out is relatively—you are not interested in that. What you are interested in is what power can you get at the end of the system or at the device that you want to move.

Q. 56. In other words, at the place where the work is to be done?

A. At the place where the work is to be done. So that any loss due to pressure drop, of course, means that you get that much less work available where the work is to be done.

Q. 57. And I take it that when you have tubing it's easy to make long sweeping bends?

A. That is right.

Q. 58. And that, too, helps?

A. That helps.

Q. 59. So that the use of tubing, together with the fitting, makes for good installation?

A. That is right. [150]

Q. 60. You have heard mentioned a term "vapor lock." Will you please explain what is meant by that, as briefly as you can?

A. Well, vapor lock is where the vapor pres-

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sure of the fuel equals or is greater than the existing pressure in the fluid, and when that point occurs, of course, you can no longer pull fuel with a suction, because the more suction you put on the fuel, the more vapor pressure of the fuel tending to vaporize exceeds the pressure surrounding the fuel, or the pressure on the fuel itself, and the more fuel becomes vapor and there is no flow of liquid fuel.

Q. 61. I take it that lead pipe or lead tubing, if we can use that term, would not be suitable for any high-pressure installations?

A. No; it wouldn't.

Q. 62. And it wouldn't be suitable for any airplane installations because of weight in addition?

A. That is right.

Q. 63. And that's likewise true with respect to iron pipe? A. That is right.

Q. 64. So it is desirable to use a type of tubing that permits easy bending so as to be compact and yet relatively light? [151] A. Right.

Q. 65. And it is a fact that it is the use of that kind of tubing that has the advantages that I have just mentioned that brings about the necessity for a fitting?

A. Some means of coupling; yes.

Q. 66. And when you refer to "means of coupling," I take it that you also mean "means for uncoupling"? A. That is right.

Q. 67. Is it true that in connection with the aviation industry there is continual assembly and

(Deposition of Robert Henry Davies.)
disassembly of the component parts that go to make up the airplane? A. Yes; it is.

Q. 68. Is that because of the tremendous stresses and strains that are employed upon the installation in actual use?

A. To some extent, and also it's due to the fact that all aircraft equipment is designed very close to the line. In other words, pumps, for instance, instead of being designed to work forever, like they are in the machine tool industry where there is no weight problem involved, they are designed as light as they possibly can be, and therefore they have a limited service. They can only run so many hours before they have to be removed and overhauled. And, of course, the way you connect the tubing up to the pump is with a fitting, so you have got to have [152] fittings that can be readily disassembled.

Q. 69. You heard mention this morning about the AC811 fitting and that during the early portion of the war a good many of those fittings were sold and later on the AN took over; that is correct, is it not? A. That is correct.

Q. 70. At the present time, what is the recognized standard fitting for the aircraft industry; particularly aircraft manufactured for the government? A. AN fittings.

Q. 71. And has the AN fitting superseded in a great measure the AC811? A. It has; yes.

Q. 72. And I understood you to say that the feature of the angle on the outside surface of the

(Deposition of Robert Henry Davies.)
sleeve is carried over from the AC811 to the AN by Parker?

A. That is right. Well, it was put on the AN by the government at the recommendation of Parker.

Q. 73. In order to incorporate the feature that Parker had in its AC811 fitting?

A. That is correct.

Q. 74. I call your attention to Amon Deposition Exhibit 1, and will ask you to describe it as to its component parts, referring also to the drawing, Amon Exhibit 2, which is an illustration of the fitting itself. [153]

A. Well, it's a three-piece coupling consisting of a body, a nut, and a sleeve. How much detail do you want me to go on them?

Q. 75. The thing I am going to ask you then is: What are the features of the relationship of these three pieces that you have just mentioned? How do they operate? What do they do, one piece with respect to the other?

A. Well, the purpose of the nose, of course, is to provide a sealing surface for the flared tube to come up against. The purpose of the sleeve is to provide the means of clamping the flare of the flared tube against the nose of the fitting. And the purpose of the nut is to pull down and apply the force to the sleeve to make the clamping of the flare and thus make the joint.

Q. 76. I note upon Exhibit 2 the term "sleeve head angle," which you said was carried over from

(Deposition of Robert Henry Davies.)
the AC811 to the AN at the suggestion of the Parker Company. A. That is right.

Q. 77. Now, proceed to tell me what is the purpose of that sleeve head angle. What does it do?

A. Well, the purpose of the sleeve head angle is to permit the expansion of the toe of the sleeve, if I may use the word "toe." I notice it isn't on here. But when the fitting is assembled so that—I don't know how much detail you want me to get into. [154]

Q. 78. Go right ahead and give us the whole story, if you can, with respect to the sleeve head angle.

A. Well, it's a small angle, so that the sleeve when it is expanded will stay within the elastic limit and not take a permanent deformation, and as long as you can keep the deformation of the toe of the sleeve within the elastic limit of the material, then when you relieve the pressure by backing off on the nut the sleeve will spring back again in the position shown in Amon Deposition Exhibit 2 and will permit the fitting to be disassembled.

Q. 79. Do I understand, then, that so long as the nut is moved to its fully tightened position that the toe of the sleeve has been slightly expanded so as to bring about a tension upon the flare of the tube; is that correct?

A. That is correct. If you tighten the fitting to any place within the recommended torque range of the fitting, the toe of the sleeve has been expanded within the elastic limit but sufficient to put the nose under hoop tension.

(Deposition of Robert Henry Davies.)

Q. 80. Now, you use the term "hoop tension." Does that mean a tension that is constantly being applied so long as the fitting is in a tightened position?

A. As long as the sleeve is deformed or the toe of the sleeve is expanded, then the sleeve is in hoop tension.

Q. 81. You use the word "deformed." You don't mean put out of commission? [155]

A. No. I should maybe have said "deflected," instead of "deformed."

Q. 82. Or "extended"?

A. Right. It's not a permanent deformation, as long as it's within the elastic limit of the sleeve.

Q. 83. If we use the term "deformation," that is a desired deformation? A. That is right.

Q. 84. And one intentionally brought about by the use of the sleeve head angle?

A. That is right.

Q. 85. Now, you mentioned something about the nut backing away and that the sleeve contracts so as to permit the nut to back away. Will you please explain just what you mean by that?

A. Well, as you loosen the nut, you reduce the load on the sleeve, and as you reduce the load on the sleeve, the sleeve, having been deflected within its elastic limit, returns to its original position, as shown in Amon Exhibit 2, which allows the nut to turn freely on the sleeve and to be backed off without any seizing or galling of the parts.

Q. 86. And does the sleeve head angle likewise

(Deposition of Robert Henry Davies.)

permit the easy passage of the threads of the nut rearwardly without engaging or gouging the sleeve? [156]

A. Yes; it does. It has sort of the effect that any tapered piece would have, making it easy to slide off.

Q. 87. And is that likewise a feature of the Parker fitting? A. Yes; that is.

Q. 88. Is that an important feature?

A. Yes; it is.

Q. 89. You have heard the term "nut jamming" used. Can you explain that for us?

A. Well, as referred to here, I believe nut jamming means that the sleeve and the nut would become jammed together or there would be seizing of the two parts so that when you attempted to rotate the nut you would have to rotate the sleeve at the same time.

Q. 90. Well, what's wrong with that? Why not operate the nut and the sleeve together?

A. Well, then you don't have a three-piece fitting any more, you have a two-piece fitting.

Q. 91. Well, is there anything wrong with that? Does it bring about any result that is not desired?

A. Well, you loose all the advantages of the three-piece fitting. For instance, you can't then telescope the nut backward over the sleeve in order to disassemble the joint when there is a bend up close to the sleeve.

Q. 92. When you say "bend up close to the sleeve" you mean [157] a bend in the tube?

(Deposition of Robert Henry Davies.)

A. A bend in the tube up close to the sleeve.

Q. 93. Proceed.

A. Then also, of course, particularly with aluminum tubing, you have a tendency to gall the flare when the tube moves together, because as you rotate the nut you rotate the sleeve on the flare and that will gall the material and may cause the parts to actually seize so that you can't even remove the fitting. And then, of course, you also have the part that you don't have any self-centering features to the sleeve any more after they have hardened together and become one part.

Q. 94. Is there any disadvantage in having the sleeve rotate with respect to the tube?

A. Yes; it causes galling on the surface of the flare and could damage the flare to such an extent that if you wanted to re-install it again you would have to cut off the tube and flare it to get a smooth flare. Then, of course, it has a weakening effect on it. It causes a lot of tears, just like if you crease a piece of paper, something like that. You could crease the flare to the point where it would be weakened. If there was any vibration applied to it, you would have stress concentration at those points and you would have earlier fatigue failure than you would have if you hadn't caused the flare to be galled. [158]

Q. 95. So that the record is straight, what you are saying is that any scoring of the tube brought about by the sleeve would bring about a weakened condition at that particular point?

(Deposition of Robert Henry Davies.)

A. That is right.

Q. 96. And then vibration fatigue would set up faster? A. That is right.

Q. 97. I take it that it is desirable to have the sleeve stay put with respect to the tube?

A. That is right.

Q. 98. Will you point out wherein the nut engages the sleeve on Exhibit 2?

A. The nut engages the sleeve at this point here where it says the two contact, at the point, that is, the nut shoulder and the sleeve shoulder.

Q. 99. And is it desirable to have the surfaces of engagement at a maximum? A. Yes; it is.

Q. 100. And is it true that the toe of the sleeve moves outwardly as the nut is tightened?

A. Yes.

Q. 101. So that the angular position of the sleeve with respect to the inside surface of the nut in fact becomes more parallel as the sleeve expands?

A. That is right. [159]

Q. 102. Does that do anything at all or change the amount of engagement between the sleeve shoulder and the nut shoulder?

A. No; it might have some very small effect, but I should think that it wouldn't have any appreciable effect.

Q. 103. In other words, the advantage of having the maximum contact between the sleeve shoulder and the nut shoulder is not impaired by the expandability or the extension of the toe of the sleeve?

A. No.

(Deposition of Robert Henry Davies.)

Q. 104. You see the word "torque" and while we sometimes understand that, let's get into the record just what you mean by torque.

A. Torque is—well, the simplest way, I guess, to explain it, it's a twisting force. In actual numbers, it's the force applied multiplied by the length of the arm on which the force is applied. Like if I have a nut, for instance, and I apply ten pounds to a ten-inch wrench, I have one hundred inch pounds of torque.

Q. 105. Well, perhaps for my education, then, is it true that when we put what we call the maximum torque or even the average between minimum and maximum on the nut it is in effect driving the nut home for its holding position to bring about a complete coupling; correct?

A. That is correct. [160]

Q. 106. And when we talk about "minimum" that's the smallest amount of driving home of the nut that is permissible?

A. That's the smallest amount that on a series of tests have indicated that you can get a satisfactory joint.

Q. 107. So that when we say, "the average amount of torque," we are in effect saying that the nut is screwed onto the body for proper holding position? A. That is right.

Q. 108. Is there any danger of possible over torquing; in other words, going beyond the maximum?

A. Yes; there is not only danger but it happens

(Deposition of Robert Henry Davies.)
frequently, particularly in the smaller sized fittings where it's very easy to put—the torques required to make the joint are relatively small, and it's very easy for a heavy-handed mechanic with a wrench to put too much torque on the fittings.

Q. 109. So that notwithstanding what may be requirements or specifications for the operator, the operator has some variable?

A. Yes; there is no way of controlling it unless you equip every mechanic with a torque wrench, which is obviously not practical.

Q. 110. If there is some slight amount of over-torquing, does the sleeve head angle play any part that permits such [161] over-torquing without necessarily ruining or spoiling the coupling?

A. Yes; the coupling can be over-torqued. I believe the over-tightening torque is considerably higher than, not just a little bit higher than, the maximum allowable torque, and the fitting has demonstrated in test its ability to be assembled and disassembled—I believe it's 15 times, or ten times maybe it is, under over-tightened torque conditions where the fitting is sometimes pulled down to such an extent that the flare is considerably damaged, but the fitting still holds pressure and the sleeve angle, the head angle on the sleeve, and the various other components of the fitting are such that when the nut is backed off, it turns freely on the sleeve and the nut can be pulled back off the fitting and there is no mechanical twist imparted in the tube.

Q. 111. And is that because of the greater clear-

(Deposition of Robert Henry Davies.)
ance or the angular clearance between the toe end of the sleeve and the wall of the nut?

A. In my opinion, it is.

Q. 112. Well, you know that to be a fact from actual experience? A. That is right.

Q. 113. And you have had actual experience in actually putting fittings on tubes? [162]

A. That is right.

Q. 114. In other words, you have actually done the mechanical end of it as well as the engineering end of it? A. That is right.

Q. 115. I now call your attention to Amon Exhibit 9 and the drawing Amon Exhibit 8, which illustrates a comparable fitting, and I will ask you to describe briefly wherein it differs from the AN fitting Amon Exhibit 1 and the drawing Amon Exhibit 2?

A. Well, it differs in that the sleeve has a double angle.

Q. 116. Now you are talking specifically about the sleeve? A. That's all.

Q. 117. Wherein is that double angle? On the inside or the outside of the sleeve? Will you point it out?

A. The double angle is indicated on Amon Exhibit 8 by the words "double differential angle," and it is on the inside of the sleeve. There are two different conical surfaces on the inside of the sleeve.

Q. 118. And the part that you have just pointed out on the sleeve and which you have referred to as

(Deposition of Robert Henry Davies.)
the double angle does, in fact, engage the outer surface of the flare of the tube?

A. Yes; it does.

Q. 119. Will you explain just what happens when you [163] start the engagement of the sleeve with the flared tube and then you begin to tighten up the nut? Tell us just what takes place, if you can, a word picture of what takes place physically.

A. Well, Amon Exhibit 8 indicates the fitting taken up, I should say, approximately finger tight. There has been no deflection of the sleeve and there has been no digging in to the flare of the nose of the sleeve or the toe of the sleeve. As you tighten it up to, let's say, the minimum torque, the first thing that happens is that some of the sleeve head angle is taken up as the toe of the sleeve expands. Also, probably if it's soft aluminum tubing, the nose or the toe of the sleeve, since it's made contact with the flare, the outside surface of the flare first begins to dig into that flare a little bit. Then as we go up to the maximum allowable torque, that digging-in increases and forces up a little blob of material probably under the toe of the sleeve, which helps the tensile pull-out strength of the fitting, incidentally, and the sleeve head angle by that time is practically parallel with the inside of the sleeve—or of the nut, rather. Then as you go into an over-tightened condition, the sleeve head angle becomes actually parallel and perhaps even a little the other way and is stopped from expanding any further by the inside surface of the nut so

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that it can't [164] be deformed sufficiently or deflected sufficiently to exceed its elastic limit and thus take a permanent deformation. In the meantime, the 33 degree conical surface on the inside of the flare has probably bitten well through the flare. However, due to the 18½ degree section, there is still a wedge of flare left for the sleeve to hold onto. And this is repeated several times, as it is in the repeated make-up tests, the 33 degree part of the sleeve keeps biting further and further through, but even if it should bite completely through the flare, there is still a wedge of tubing clamped between the nose of the tubing and the sleeve by the 18½ degree part of the sleeve.

Q. 120. Then do I understand, using the term that you use, the 18½ degree angle on the sleeve and the angle on the flare of the tube, that they substantially assume each other?

A. That is right; at the over-tightened condition.

Q. 121. In other words, at the fully-tightened condition, the space which is illustrated in Amon Exhibit 2 between the angle of the flare and the 18½ degree angle of the sleeve, that differential disappears?

A. Substantially; yes. I wouldn't say definitely right at the maximum torque, but certainly not too far over that it would disappear. [165]

Q. 122. Well, am I correct in my understanding that whatever space is illustrated at finger-tight tightening of the nut that that space becomes less and less as the nut is driven home?

(Deposition of Robert Henry Davies.)

A. Oh, yes; definitely.

Q. 123. The term "differential angle" has been used. What do you intend to mean with respect to differential angle?

A. Well, by differential angle in a fitting of this type we are referring to a difference in angle between the inside of the sleeve and the outside of the flare with which it mates as the fitting is taken up.

Q. 124. Then am I correct that in a device as illustrated in Physical Exhibit 9 and Drawing Exhibit 8 that the sleeve engages the flare of the tube toward the toe first? A. Yes; at the toe.

Q. 125. Is that what we might call initial contact or toe contact?

A. That's the initial contact at the toe of the sleeve.

Q. 126. And as you drive the nut or rotate the nut to bring it home, that contact, instead of being over a small area as between the sleeve and the flare, becomes greater?

A. Yes; it becomes greater. As the toe of [166] the sleeve expands under a load that we described before, the area of contact of the inner surface of the sleeve and the outer surface of the flare becomes more. And, of course, also, as the flare is deformed slightly, it becomes more, too.

Q. 127. I think you mentioned something about repeated tests and the possible pinching off of the flare. Well, in the event that there is pinching off of the flare by a Parker type fitting as exemplified in Amon Exhibit 8, you still have proper holding

(Deposition of Robert Henry Davies.)

facilities, and do you still have a fluid tight coupling capable of withstanding the necessary pressures used in the aviation industry?

A. You still have a joint that's tight and that is strong enough to withstand the burst pressure of the tubing, which is probably some place in the neighborhood of twelve or fifteen thousand pounds per square inch, which is three or four times as high as any working pressures.

Q. 128. And even though you have pinching off or possible pinching off due to the differential angle and the initial toe contact, you still get a good joint? A. Yes; you do.

Q. 129. And what you are now telling me is from the experience that you yourself have observed over a period of years with The Parker Appliance Company? [167]

A. Yes; and also on a lot of tests that have been run on this by Parker as well as a lot of other people.

Q. 130. In addition to Parker's tests that you personally know about, you have had occasion to observe tests and test reports made by purchasers and users of the fittings of the kind exemplified by Amon Exhibit 9? A. Yes; I have.

Q. 131. Incidentally, Mr. Davies, the drawings that have heretofore been referred to as Amon Exhibits 2 and 8, do you know whether or not they are accurate drawings with respect to Parker type fittings of the kind exemplified by the physical models here, Exhibits 1 and 9,

(Deposition of Robert Henry Davies.)

A. Yes; they are. They are as exact as it's possible to make them on a drawing board. I believe they are five times scaled and they are, I believe, No. 4 fittings, if I am not mistaken. I couldn't be sure of that. But I know that they were drawn to scale as carefully as they could be, so that the relationships, although the actual measurements are five times bigger than they really are, at least the relationships and the clearances, and so forth, are in proportion to what they are in the actual fitting.

Q. 132. In other words, the various angles and the component parts that make up the entire drawing are all properly relative to each other? [168]

A. That is right.

Q. 133. And they do, in fact, illustrate the Parker type fitting of Exhibit 1 and Exhibit 9, respectively? A. Yes; they do.

Q. 134. Is there any bad result when the nut is fully torqued or driven home in having the tube twist with respect to the body of the coupling?

A. Yes; that's a very bad situation. In fact, that's one of the things that in the AN-F-47 specification, there is a specification on that point where you must torque up your fitting and you must have a torque indicating device on the tubing to indicate that the force tending to twist the tube must be held to a minimum, because there is a lot of stress in the tube. The tube is designed to stand the stress that it's normally subjected to by the pressure and

(Deposition of Robert Henry Davies.)

the surges, and so forth, of the system, but if you add a mechanical stress in addition to the hydraulic stress, such as you would by putting a twist in it, then you are liable to stress the tube beyond its strength and you are liabel to have a tubing failure.

Q. 135. You mentioned the NAF fitting specification or requirement?

A. No; I said the AN-F-47 specification.

Q. 136. Oh, I am sorry. Then coming back to the NAF fitting, that was a two-piece fitting? [169]

A. That is right.

Q. 137. And in that type fitting, when the nut is driven home, the nut actually engages the flare?

A. That is right.

Q. 138. So that as the nut is rotated, there is this gouging or scoring action of the nut with respect to the flare?

A. There is; that is right.

Q. 139. And as the nut is fully tightened, there is, of course, a greater gripping and a tendency of twisting of the tube? A. That is right.

Q. 140. In connection with your AN fitting or the Parker type fitting, the only point of contact between the nut and the sleeve is that region which you have called or Mr. Amon has called the sleeve shoulder and nut shoulder; correct?

A. That is correct.

Q. 141. And if there is any wiping or scoring action there, does it in any way impair the strength of the tube? A. No; it does not.

(Deposition of Robert Henry Davies.)

Q. 142. Does it in any way impair or affect the operating characteristics of the coupling complete?

A. No; it doesn't, unless the scoring should be so bad that it should tend to make the two parts seize, but that's not likely, because, as a rule, they are two different [170] materials. The sleeve is usually Duronze No. 3 whereas the nut is aluminum alloy, and so therefore you don't get very much chance of seizure to take place between those two materials.

Q. 143. Aside from seizure, if there is any scoring or roughening of the region of contact between the sleeve and the nut, that doesn't affect proper operation?

A. No; that doesn't bother the fitting.

Q. 144. Is it true that the material of the sleeve may be hardened or relatively harder than the material of the nut?

A. Yes; the Duronze No. 3 material that I mentioned before has a tensile strength of about 95,000 pounds per square inch against probably 40,000 pounds per square inch for the nut, the aluminum alloy nut.

Q. 145. In the sleeve that we have here illustrated in either Exhibits 2 or 8 you permit it to expand. Now, does the material have any effect on that expansion?

A. Yes; it's desirable to use a material that is resilient; that is, it will not take a permanent set when it's expanded and it is also of high tensile strength so that it resists expansion so that it can

(Deposition of Robert Henry Davies.)

take a relatively high torque without expanding clear out to the point where it touches the inside of the nut, because when it does that, then you start to put those strains against the aluminum [171] alloy nut, which, of course, is not as strong as the sleeve.

Q. 146. And is it true that the sleeve is relatively thin with respect to the thickness of the nut?

A. Yes; it is. It's considerably thinner, as you can see from these exhibits.

Q. 147. And does the AN fitting give you hoop tension of a thin body against the flare as distinguished from a thick nut engaging the flare?

A. Yes; it does, because the toe of the fitting, of course, is quite thin and therefore, of course, the hoop tension is greater, because the deflection of the sleeve is greater at the nose where it's thin.

Q. 148. Do I understand that the hoop tension varies in degree from the nose rearwardly towards the region of contact?

A. In this case it does; yes.

Q. 149. And by "in this case" you are now referring to——

A. Amon Exhibit 8.

Q. 150. And is that likewise true in Exhibit 2?

A. Let's see, the deflection in Exhibit 2 would become less and less as you went farther back on the sleeve, but the actual tension would be about the same until you had gone as far back as the base of the flare and then it would reduce to nothing, be-

(Deposition of Robert Henry Davies.)
cause there would be no force tending to distort the sleeve at that point. [172]

Q. 151. Then is it true that at the toe you have the greatest amount of let's call it hoop tension?

A. That is right.

Q. 152. I think I used the term heretofore that the AN superseded the 811. That is a fact in connection with the aviation industry?

A. That is right.

Q. 153. Does that same thing hold true with respect to certain industrial applications?

A. Well, most industrial applications today are the Parker triple fitting, which is actually the AC811 fitting.

Q. 154. And has there been a tendency even in the industrial field to go from the AC811 to the AN type fitting?

A. Well, there has been a tendency, but there hasn't been very many used as yet, but there has been at least one standard that I know of that has been established based around the AN fitting.

Q. 155. So that the industrial field is now following that which the government followed some years ago? A. That is right.

Q. 156. And the AN is becoming standard at least in certain applications?

A. That is right.

Q. 157. There was some question this morning with respect to the NAF fitting as being standard with the Navy at one [173] time.

A. The NAF fitting?

(Deposition of Robert Henry Davies.)

Q. 158. Yes.

A. Yes; the NAF310500.

Q. 159. What is standard now with the Navy?

A. The AN fitting is standard with the Navy.

Q. 160. When you say "AN," you are talking about the Parker type fitting?

A. I am talking about the Parker type fitting as illustrated by Amon Exhibit 1, Amon Exhibit 7, and Amon Exhibit 9.

Q. 161. Is there any weight or strength advantage in a flared fitting with an outside angle on the sleeve?

A. Well, there is at least a strength-weight advantage to a three-piece fitting over a two-piece fitting, and to have a three-piece fitting operate satisfactorily it is very desirable to have the sleeve head angle. Does that answer the question?

Q. 162. Well, the sleeve head angle, then, permits the easy disassembly of the nut?

A. That is right.

Q. 163. It prevents jamming or freezing of the nut with respect to the sleeve?

A. That is right.

Q. 164. It permits expansion at the nose end of the [174] sleeve? A. That is right.

Q. 165. And it likewise brings about what you have referred to as hoop tension of the sleeve with respect to the flare of the tube?

A. That is right.

Q. 166. The term "wire lock" has been used, and I am going to ask you whether during the war or

(Deposition of Robert Henry Davies.)
shortly thereafter you had any occasion to make any study of the German planes on behalf of the government?

A. Yes; I spent about three and a half months in Germany studying the developments in the German aircraft accessory industry, including fuel system valves, hydraulic system valves, fuel system fittings, and hydraulic system fittings.

Q. 167. And what did you find with respect to wire locking?

A. Well, the Germans wire lock—it was a requirement of the German aircraft that they wire lock all their fittings.

Q. 168. In other words, when you say "wire lock all their fittings," you are talking about the fittings wherein tubes were coupled to work units?

A. That is right; they had to wire lock the fitting both places. They wire locked the fitting where it was screwed [175] into a box and they wire locked the nut where it was screwed onto the fitting.

Q. 169. Does the hoop tension prevent in a measure the backing away or the nut becoming loose during normal operation of the coupling?

A. Yes; it does.

Q. 170. Just explain that so that we can get it on the record, the complete explanation.

A. Well, it acts just similar to what a lock washer would act under an ordinary screw in that as long as the toe of the sleeve is under hoop tension it's trying to get back to its original position and therefore it's pressing down against the flare and,

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of course, as long as it presses down against the flare it must react against something else, so it reacts up against the sleeve shoulder and the nut shoulder here, which in turn pulls the nut up, as it's shown in both these Amon Exhibits, 2 and 8, so that all of the clearance in the threads is taken up and it's holding it up there and it's causing friction between the surfaces of the threads so that it will not back off easily under vibration. In fact, I don't know of any case I have ever heard of where a fitting has backed off under vibration.

Q. 171. And then that hoop tension is continued on during the life, that is, the operative life of the coupling? [176]

A. Yes; it is. As long as the sleeve is not stressed beyond its elastic limit, that hoop tension comes into play each time the fitting is assembled.

Q. 172. Well, it comes into play each time the fitting is assembled and it continues to play an important part until disassembled?

A. That is right.

Q. 173. So if the fitting is in use for a year, you have hoop tension for a year?

A. That is right.

Q. 174. There has been some mention about the angle of the tube flare itself being different on the inside surface than on the outside surface. Will you briefly explain what brings that about?

A. Well, that's brought about, of course, by the fact that there is the same number of cubic inches of material in the nose end of the flare after it's

(Deposition of Robert Henry Davies.)

been flared that there was before, so since it's taken a lot larger circumference than it did before, it must get narrower, and when it gets narrower that forces a difference in angle between the inside of the flare and the outside of the flare.

(Recess.)

Q. 175. Mr. Davies, have you any experience with the actual use of flaring tools for making flares? [177]

A. Yes; I have made flares with flaring tools.

Q. 176. And you are familiar with the flaring tools of the kind illustrated in the Parker catalogue, Defendants' Exhibit A? A. Yes.

Q. 177. There has been some reference to springing back of the flare after it was made due to the material from which it was made. Will you please explain just what is done to make a flare, how it functions, and what it does with respect to springing back or staying put? In other words, give us, as quickly as you can, an explanation of the making of a flare, its purpose, what it does, and so forth.

A. Well, of course, the purpose of the flare is to provide a part of the tube which the fitting can grip and which the fitting can use as a seal. The flare is made, as a rule, by having a female die in which the tube is swaged or expanded into by means of a male tool, and, of course, in so doing the tubing is stressed beyond the elastic limit and therefore it does not return to its original shape but keeps the shape as determined by the tool itself. There is possibly some springing back due to this method

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of flaring, but that spring-back would be very negligible, because any of the materials which can be flared at all, such as your block annealed steel tubing and [178] your dead soft copper and your 52SO aluminium alloy, have very little resiliency or very little tendency to spring back. Some other materials might, but those materials are unsuitable for flaring. Instead of flaring, of course, they would split. Furthermore, the spring-back would not be on an angular basis, but probably, if there were any, it would spring back, leaving the faces of the flare still parallel to the tool. In other words, it would spring back as much at the base of the flare as it would at the end. Is that satisfactory?

Mr. Freeman: Just off the record.

(Discussion, off the record.)

Q. 178. In Amon Deposition Exhibits 8 and 9 there is illustrated the Parker fitting with the differential angle, and I am going to ask you what effect, if any, the differential angle has with respect to increasing the resistance to vibration fatigue?

A. Well, the differential angle would have a tendency to increase the resistance to vibration failure or fatigue failure.

Q. 179. The differential angle of the sleeve with respect to the outer wall of the flare gives you what you have termed toe or initial contact; correct?

A. Toe contact; yes.

Q. 180. Is it true that toe contact gives you a seal [179] at lower wrench torque?

(Deposition of Robert Henry Davies.)

A. Yes. As a matter of fact, we have demonstrated that you can with that toe contact take a fitting up finger tight and hold 3,000 pounds pressure without leakage if all the parts are just right.

Q. 181. Why is that result brought about?

A. Well, that's brought about because where you have the toe contacting first, you have not quite a line contact but what approaches a line contact, so that if you have, let's say, just a very low total force available from tightening of the nut, say, just with your fingers, you have a high unit pressure available at the toe, because the area is so small. In other words, suppose you have ten pounds total force or suppose you have one pound total force, but you only have a thousandths of a square inch of area contact. Then you would have 1,000 pounds per square inch pressure at the point of contact, which would help you to seal.

Q. 182. Then the initial or toe contact permits sealing at lower torque pressure?

A. That is right.

Q. 183. And as you begin to lose the differential angle because of the tightening of the nut, you then have greater surface of contact; is that correct?

A. Yes; the more you draw the nut down and the more [180] that the toe of the sleeve expands, the more area of the differential angle is brought into contact with the outer surface of the flare.

Q. 184. So that the pressure then is applied to

(Deposition of Robert Henry Davies.)

a greater area? A. That is right.

Q. 185. And then you have less pounds per square inch?

A. Well, yes, but you have got more total pounds, so maybe your pounds per square inch is about the same.

Q. 186. In other words, you have obtained more pounds because of the increased torque?

A. That is right.

Q. 187. But you initially get a sealing off at a low torque? A. That is right.

Q. 188. And as you build up and cover more area, which would normally lessen the pounds pressure, you compensate for that by the increased torque?

A. That is right; and then because you are getting more area coming into contact, you start to get more resistance to the formation of the flare.

Q. 189. Does toe contact help in sealing imperfectly rounded flares by its tendency to seal on a line?

A. Yes; it does, but, chiefly, I should say, it does by the fact that because it gives you a high [181] unit stress at that point it tends to deform the flare and to bring it—if it's imperfect, to make it perfect, so to speak, or at least to make it conform to the toe of the sleeve.

Q. 190. At the point or at the line where there is contact between the sleeve and the flare?

A. That is right.

Q. 191. And it's easier to bring that into a—

(Deposition of Robert Henry Davies.)

let's call it a perfect condition—rather than trying to change an entire flare surface?

A. That is right.

Q. 192. So that toe contact is important in that respect? A. It is.

Q. 193. Wherein does the Parker type fitting exemplified in Amon Exhibit 1 differ from other triple type fittings? In other words, what features are there in the Parker fitting that you are now looking at, Amon Exhibit 1, over and above the ordinary or conventional three-piece tube coupling?

A. Well, I don't know what you refer to by "ordinary three-piece coupling," unless you refer to some old three-piece couplings that were made by Parker at one time. I am not familiar with any other types.

Q. 194. Well, does the conventional three-piece fitting have a sleeve with a sleeve head angle? [182]

A. Not to my knowledge.

Q. 195. And is it true that in the Parker type fitting exemplified by Amon Deposition Exhibit 9 that you get initial or toe contact?

A. Yes; it is.

Q. 196. And does that likewise differ from the so-called conventional three-piece tube coupling?

A. To my knowledge, it does; yes. I have never seen one like that.

Q. 197. And that brings about these beneficial results that you have just talked about?

A. That is right.

Q. 198. And likewise the sleeve head angle, that

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is, on the outer wall of the sleeve, that, too, brings about these advantages that you have testified to with respect to the Parker type fitting?

A. Yes; I think that's right, because, as evidence of that, if I may just say a word here——

Q. 199. Go right ahead.

A. I realize that the idea of a three-piece fitting is not new, but until Parker made a three-piece fitting and incorporated some of these features that we have been talking about there was no significant use of three-piece fittings, and since that time they have not only been practically adopted as a standard in the Air Force but they also,—as [183] we pointed out before, have been taken up by machine tool and off the road equipment, and so forth, so that there must have been something in the changes which were made, which are these sleeve head angles and the initial toe contact, to make the difference between a fitting that was suitable and one that wasn't.

Q. 200. And those differences are important over the conventional three-piece coupling?

A. That is right.

Mr. Freeman: That is all.

Cross-Examination

By Mr. Beehler:

XQ. 201. Mr. Davies, you made a statement here in your direct examination, I believe, that in the setting up of the specifications for the AN

(Deposition of Robert Henry Davies.)

Standard fittings the desirable features of the AC811 were adopted; that is correct, is it?

A. In setting up the drawings, yes, I think that the specification just tells you how you are supposed to inspect, or something like that.

XQ. 202. But, in any event, the proportions, the angles, threads, dimensions, and that sort of thing?

A. No; not the specific angles, but the relationship [184] of parts. Not specific dimensions, because I don't think that specific dimensions mean anything, any more than they do if you have a small fitting and a large fitting. The dimensions themselves are different but the relationships are not different.

XQ. 203. Well, when the AN standards were set up and they undertook to take the desirable features of the AC811, at the same time they endeavored to omit the undesirable features; is that correct?

A. That is right.

XQ. 204. And it is true, is it not, that the sleeves of the AC811 are interchangeable with the sleeves of the AN Standard fitting?

A. Approximately so. Theoretically there is a possibility, I believe, in a few sizes of interference.

XQ. 205. Interchangeability, however, was recommended, was it not?

A. That is correct; it was in that. I might add there, just to be sure that we are straight, that wasn't exactly interchangeable. It was substitution. In other words, it was substitution of an AN for an 811 sleeve. That was always O. K. You couldn't do it the other way around.

(Deposition of Robert Henry Davies.)

XQ. 206. And does the AN fitting employ the same threads as employed in the AC811 fitting? [185]

A. In the Sizes 2, 3, 4 and 5, they employ the same threads, and also in the Sizes 28 and 32 they employ the same threads, and in all the other sizes the threads are different, different pitch.

XQ. 207. Were the threads adopted by the AN Standard Series the same as employed in the flared tube fitting series known as the NAF Series?

A. I believe that they were in all, but I think there was one case where they were not. I am not sure. I am not too familiar with the NAF. I believe there was a different thread diameter used in one size.

XQ. 208. In that event, then, so far as threads are concerned, they did not copy or adopt the AC811?

A. No; except in the sizes which I mentioned.

XQ. 209. With respect to the angles of the body of the AN fitting, did they copy the AC811 or did they copy the NAF body? A. The angles——

XQ. 210. On the body.

A. ——on the body? They used the NAF angle.

XQ. 211. With respect to the angle on the inside of the sleeve of the AN Standard, that angle is the same, is it not, as the inside angle of the NAF nut?

A. I believe it is, but I am not sure.

XQ. 212. Then that did not copy the AC811, am I correct? [186] A. No; that didn't.

XQ. 213. You have made some reference here to

(Deposition of Robert Henry Davies.)
the fact that Parker was not the originator of the three-piece fitting. Do I state you correctly?

A. I believe that is correct; yes.

XQ. 214. And with respect to the AN Standard there is a junction, a line of contact between the nut and the base of the head of the sleeve. Does that copy the AC811 or did that copy ordinary three-piece fittings?

A. Would you repeat that again? I missed the start of it.

Mr. Beehler: Would you read the question, please?

(Question read.)

A. You are referring to the parts marked on Amon Exhibit 2 as "sleeve shoulder" and "nut shoulder"?

XQ. 215. That is correct.

A. Well, that was taken from the 811 fitting.

XQ. 216. What else did the AN Standard copy from the AC811 sleeve?

A. The AN Standard copied from the AC811 sleeve the sleeve head angle and the differential angle between the internal surface of the sleeve and the external surface of the flare.

XQ. 217. Was there a double differential angle on the [187] AC811 sleeve?

A. There was a double angle on the AC811 sleeve and there was also a differential angle.

XQ. 218. Is the double angle on the AN the same as the double angle on the AC811?

A. In effect it is the same. Whether the actual

(Deposition of Robert Henry Davies.)

values of the angles are the same I don't know.

XQ. 219. And was Parker the originator of the double angle on the internal flare of the sleeve?

A. Parker was not the originator of the double angle.

XQ. 220. I take it, then, that Parker was not the originator of the double differential angle either; is that correct?

A. Parker was the originator of the differential angle, to the best of my knowledge.

XQ. 221. Well, what is the differential angle, will you tell me that?

A. The differential angle is the difference between the angle that is marked on Amon Exhibit 2 as "sleeve angle"—wait a minute. I had better use the other exhibit. I will take this one. (Continuing) —between the angle on the internal surface of the sleeve and the external surface of the flare.

XQ. 222. Am I right in interpreting your remarks to mean [188] that if the internal angle on the flare and the sleeve head angle are parallel, there is not a differential angle? Is that a correct interpretation of your definition?

A. By "sleeve head angle" you are referring to this angle out here?

XQ. 223. The inside angle on the sleeve?

A. Well, that is not the sleeve head angle. We have been referring to the sleeve head angle as this out here.

XQ. 224. Thank you for correcting me. "Sleeve angle" I intended to say.

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A. If the two are parallel, then there is no differential angle; that is correct.

XQ. 225. All right. You said a short time ago that Parker originated the differential angle?

A. I believe they did.

XQ. 226. Did he originate a differential angle wherein the sleeve angle, as identified on Exhibit 2, was less than the external angle of the flare or wherein the sleeve angle is greater than the external angle of the flare?

A. Where the sleeve angle is less than the external angle of the flare.

XQ. 227. Is that the differential angle that the AN Standard copied from the AC811 Series? [189]

A. That is.

XQ. 228. Am I to understand, then, that on the AC811 Series the sleeve angle in all instances is less than the external angle on the flare of the tube?

A. No; not in all instances. Only in the smaller sizes.

XQ. 229. Will you identify the sizes, please?

A. 2, 3, 4, 5, and 6, I believe.

XQ. 230. And with respect to sizes other than 2, 3, 4, 5, and 6, is there a differential angle in the AC811 Series? A. I believe there is not.

XQ. 231. Then with respect to those sizes there was no copying, was there, in the AN Standard from the AC811?

A. Well, the AC811, in those sizes, the AN fitting has no differential angle in those larger sizes.

(Deposition of Robert Henry Davies.)

XQ. 232. Then in those larger sizes there is no hoop stress; is that correct?

A. No; that's not correct. In the larger sizes there is hoop stress.

XQ. 233. You mentioned the fact that initially tubing systems in aircraft were suitable for relatively low pressures as contrasted with the use of tubing systems later for high pressures, which you identified as pressures in the neighborhood of 3,000 pounds. Is there any difference in principle, so far as the three-piece AN coupling is concerned, between couplings which are suited to the use of [190] tubing for high pressures and those which are suited to the use of tubing for low pressures?

A. Well, there is a difference in that, for instance, a fittng that is satisfactory for low-pressure installations might not be satisfactory for high pressure. However, a high-pressure fitting probably would be suitable for low-pressure installations.

XQ. 234. Does that result from a difference in principle or a difference in the material which is used?

A. Well, it probably results from both. Take, for instance, the automotive industry, which uses a flared type fitting, which is perfectly satisfactory for automotive work but would not be satisfactory for aircraft or machine tool work, because the automotive companies themselves when they buy fittings for maintenance on their hydraulic equipment use a different type of fitting from what they use on the

(Deposition of Robert Henry Davies.)

fuel line installation in their automobile. Yet the material is brass and copper, the same.

XQ. 235. It works on a different principle; is that right?

A. It works on a different principle. It's a flared fitting, but it doesn't have some of the features that the flared fittings that we are talkng about here have.

XQ. 236. You mentioned the desirability of being able [191] to reassemble the AN Standard fittings? A. That is right.

XQ. 237. The three-piece fittings?

A. That is right.

XQ. 238. When you reassemble a three-piece fitting, is it not true that the head of the sleeve expands further with the second assembly than with the first?

A. No; not if the same torque is used for the second assembly. It would not expand any further with the second than it did with the first.

XQ. 239. If you reassembled ten times, would there not be a greater expansion on the tenth time than on the first?

A. If the same torque were used, there would not be.

XQ. 240. In practice is there a greater expansion the tenth time than the first?

A. In practice, I have never actually measured the amount of expansion, so I would not be in a position to say.

XQ. 241. In practice, then, if you haven't

(Deposition of Robert Henry Davies.)

measured the expansion, you can't tell whether or not there was expansion; isn't that true?

A. No; I can tell if there was expansion, because—well, no, in practice you can't tell whether there is expansion, because you can't see inside of the fitting when it's assembled. [192]

XQ. 242. Well, your remarks, then, with respect to expansion are from a purely theoretical standpoint; is that true?

A. Yes. They are, however, pretty obvious.

XQ. 243. Obvious to you, you mean?

A. Well, they are obvious to any engineer.

XQ. 244. I want to refer you for a moment, Mr. Davies, to the Parker catalogue, Defendants' Exhibit A, and particularly Page 5, and I will read the paragraph I have reference to. And I might say that this discourse is with relation to the triple type tube couplings. "The sleeve is supported solidly in the nut as the nut is tightened down. This prevents the sleeve from bulging and insures good, solid clamping action on the flare. The slight reverse angle in the outside of the sleeve prevents it from deforming during tightening and jamming onto the nut." Can you tell me what that paragraph means when it says that the sleeve is supported solidly in the nut?

A. No; I can't. I think one of our advertising characters wrote that.

XQ. 245. Can you tell me what that paragraph means when it says "this prevents the sleeve from bulging"?

(Deposition of Robert Henry Davies.)

A. No; I don't know what they meant then either.

XQ. 246. Does it not mean, Mr. Davies, that when you screw down the nut of a Parker triple type tube coupling you [193] actually jam the head of the sleeve into the nut? That's true, isn't it?

A. Well, it's not true that you do that, but that's what he might have meant. I don't know. I didn't write that.

XQ. 247. Well, it's true in practice, isn't it?

A. That you jam the head of the sleeve into the nut?

XQ. 248. Yes; when you pull it down with an ordinary torque enough to tighten the coupling?

A. No; I wouldn't say that was true.

XQ. 249. Is it never true?

A. Oh, I say it is true, yes, it can happen, but you have to put a lot more than normal torque on it to make it happen.

XQ. 250. You made some remarks with respect to hoop stress and elastic limit. Is there not inherent in any metal object a resistance to compression which is not hoop stress?

A. A resistance to compression?

XQ. 251. Yes. A. Yes.

XQ. 252. And can you not compress a metal object between two other surfaces and then release the compression and have the metal regain some of its initial shape? [194] A. Yes.

XQ. 253. Does that not happen to the head of a sleeve in a three-piece coupling?

A. Yes; it definitely must happen, but the

(Deposition of Robert Henry Davies.)

amount that it is compressed under the loads that we are talking about is so insignificant that it won't amount to anything.

XQ. 254. Will you again make reference, Mr. Davies, to Plaintiff's Exhibit 2, and I direct your attention again to the sleeve head angle previously described here as an angle one degree to one and a half degrees. Does that not provide a clearance at the free end of the head of the sleeve greater than the clearance at the butt end of the head of the sleeve.

A. Yes; the clearance at the toe of the sleeve is greater than the clearance at the butt end of the sleeve.

XQ. 255. Very well.

A. I say "toe" because I have been using the word "toe" before.

XQ. 256. Thank you. Let's use the name "toe" then. Suppose, Mr. Davies, instead of having a sleeve head angle of one and one-half degrees on the exterior of the head we extend the outside surface of the head of the sleeve back on a line parallel to the inside surface of the nut, beginning at the point where the angular pitch provides at the toe the greater clearance. Do you [195] follow me?

A. Yes; I understand. In other words, this line that's known as the sleeve head angle would be zero?

XQ. 257. Yes; that is correct. And spaced at a distance from the inside surface of the nut with the same amount of clearance as on the toe of the head of the sleeve, A. That is right.

XQ. 258. Under a circumstance like that, Mr.

(Deposition of Robert Henry Davies.)

Davies, and providing the recommended torque which you refer to as the one used when the coupling is made up, after making up a coupling of that design, would you not have the hoop stress previously referred to? A. Yes; you would.

XQ. 259. And would you not have the same position on the toe of the sleeve with respect to expansion as you do in the coupling as illustrated in Exhibit 2?

A. The toe of the sleeve would be in the same position as it would be, approximately; yes.

XQ. 260. As it would be if you had a sleeve head angle as previously described?

A. That is right.

XQ. 261. And then, therefore, would not a coupling without the 1½-inch sleeve head angle be just as good *as good* as one with the exterior surface of the head cylindrical?

A. Would you repeat that question? [196]

Mr. Beehler: Read the question, please.

(Question read.)

Mr. Beehler: I will have to re-phrase it.

XQ. 262. Would not, therefore, a coupling without the sleeve head angle, namely, with the head of the sleeve cylindrical, be just as good as the coupling illustrated in Plaintiff's Exhibit 2?

A. No; I don't think it would be quite as good. It would certainly be better than one that didn't have any clearance, but you won't have quite as much contact back on the sleeve shoulder and the nut shoulder as you have with the taper.

(Deposition of Robert Henry Davies.)

XQ. 263. That contact would be diminished by about two-thousandths of an inch on each side; is that right?

A. I don't know the exact figures, but I would say that maybe that could be right.

XQ. 264. The drawing shows the corner of the butt end of the head of the sleeve broken. The corner is broken by more than two-thousandths of an inch, isn't it? A. Yes; I would say it was.

XQ. 265. So that if we reduced the diameter by two-thousandths of an inch, we would still have the same amount of shoulder to shoulder to contact, would we not?

A. No; because then you have to break the corner the same amount and you just move the corner break in that [197] much farther.

XQ. 266. Well, if we broke the corner a less amount, then we still have the same amount of shoulder to shoulder contact?

A. Right; but then you wouldn't have as good a fitting, because you wouldn't have your corner broken as much and you would have more stress concentration at the corner.

XQ. 267. Well, then, is it not true that the sole advantage of the AN fitting there pictured in sizes over 6 exist in providing a sleeve head angle of 1½ degrees instead of providing a corresponding amount in clearance on a cylindrical sleeve head? That's true, isn't it?

A. That's the only difference between the—well, let me have that question again, please.

(Deposition of Robert Henry Davies.)

(Question read.)

A. Well, the advantage over what?

XQ. 268. Well, over the AC811 sleeve, for example?

A. No; because the AC811 sleeve had that same sleeve head angle, so the AN has no advantage over the 811 for that reason.

XQ. 269. With respect to the AN sleeve, the sole advantage that the AN sleeve has over an ordinary three-piece coupling is the presence of a 1½-degree sleeve head angle instead of a corrsponding amount of clearance [198] gained by a cylindrical exterior?

A. Well, that is the only advantage, if you want to call it that, but I don't know of any three-piece fitting that does not have the sleeve head angle. I mean, you are talking about a hypothetical three-piece fitting that would not have the sleeve head angle.

XQ. 270. You also mentioned torque, Mr. Davies, and I refer particularly to the torque effect on the tube, and you said, if I remember correctly, that it was desirable not to have too much torque or twist on the tube when the coupling was made up; is that correct? A. That is correct.

XQ. 271. In comparing the torque effect on the tube of a tube coupled with a three-piece AN fitting and the torque on a tube with a two-piece flared fitting, on which is the torque greater?

A. The torque on the tube is greater on the two-

(Deposition of Robert Henry Davies.)
piece fitting than it would be on the three-piece fitting.

XQ. 272. You are absolutely certain of that statement? A. Yes; I am.

XQ. 273. Just a minute ago, Mr. Davies, if I may backtrack a little bit, we spoke of breaking the corner on the butt end of the head of the sleeve, and you said, I believe, that that was undesirable?

A. Breaking the corner—— [199]

XQ. 274. On the butt end of the head of the sleeve.

A. I didn't say that was undesirable. I said it was desirable.

XQ. 275. It was desirable to break the corner?

A. That is right.

XQ. 276. Fine. Why is it desirable to break the corner?

A. Well, it's desirable to break all sharp corners, because at sharp corners is where you get stress concentrations that cause failure. I mean, that's a standard practice in any machining operation is to break sharp corners.

XQ. 277. Is there stress on an extra corner that needs to be broken by breaking the corner?

A. No; there isn't, but there would be a stress concentration on the nut at that mating internal corner, and that has to be filleted, and if that's filleted in order to avoid just a point contact at that point, it's necessary to break the corner on the sleeve.

XQ. 278. Thank you. Now, referring once again,

(Deposition of Robert Henry Davies.)
Mr. Davies, to Plaintiff's Exhibit 8, you spoke of toe contact. A. Right.

XQ. 279. And you meant, I believe, by toe contact the contact of that portion of the inside of the sleeve identified as having the 33-degree flare?

A. Correct. [200]

XQ. 280. This morning, I believe you heard Mr. Amon testify to the effect that the 33-degree portion was about half as much as the 18½-degree portion; is that correct?

A. I believe he did say that, although I am not sure.

XQ. 281. Well, is that correct from your own experience?

A. Well, I will take a look at it. Yes; that's about right.

XQ. 282. Well, with the toe, then, about one-half of the portion of greater angularity, the toe portion or the toe contact is then a surface to surface contact, isn't it? A. It is.

XQ. 283. It is not a line contact?

A. No; it is not.

XQ. 284. And if a line contact does develop as the nut is screwed up, is it not true that the line contact, if such there be, lies at the angle between the 33-degree part and the 18½-degree part?

A. Well, no line contact would ever develop with the sleeve as it's shown on Exhibit 8. No actual line contact, in other words.

XQ. 285. You mentioned a digging in of the sleeve into the flare? A. That is right.

(Deposition of Robert Henry Davies.)

XQ. 286. The digging-in would be at a maximum at the junction of those two angles, would it not? [201]

A. No; the digging-in would be on the 33-degree surface. That's where your digging-in would be.

XQ. 287. You mean, it would be a surface digging?

A. It would be a surface digging. In other words, the 33-degree surface is only about 10 to 15-thousandths long. Whereas 10 to 15-thousandths is a measurable distance, it is still a relatively small distance, and for that reason there would be unit pressures on that area, and therefore that area would be the part that would dig in. Any line contact, so-called, is actually an area contact, if you want to get down to small enough values.

XQ. 288. Well, just to correlate our terms, if the 33-degree portion is a small area of contact and it's 15-thousandths, then the 18½-degree part, which is only twice as long, is that small or great?

A. No; that's twice as much.

XQ. 289. Still small, isn't it?

A. Yes; the fitting is still small; sure.

XQ. 290. Right back where we were talking with respect to the 33-degree portion on the sleeve, as the coupling of Exhibit 8 is drawn up, the toe, as you term it, of the sleeve starts to expand, does it not? A. That is correct.

XQ. 291. And as it starts to expand, it tends to pull away from the flare, does it not, at the extreme end? [202]

A. Let's see what you mean by "pull away from

(Deposition of Robert Henry Davies.)

the flare." It's being pushed——

XQ. 292. It's being driven away?

A. Driven into the flare rather than driven away from it.

XQ. 293. It's being pushed to a diameter greater than it had to start with?

A. That is right; but, of course, as it's being pushed to that diameter, it's also being pushed downward and digging into the flare. It's digging into the flare, not going away from it.

XQ. 294. You mean, it digs in as much as it spreads; is that right? A. No.

XQ. 295. So that the angularity of 33 degrees does not change?

A. No; the angularity of 33 degrees does change.

XQ. 296. Gets greater?

A. Gets greater, because the sleeve pivots about a point.

XQ. 297. You were talking also, Mr. Davies, about making up a flare with a flaring tool?

A. Yes.

XQ. 298. And you said, if I remember correctly, that with respect to spring-back there would be as much spring-back [203] at the outer extremity of the flare as there would be at the base of the flare; is that right?

A. I said first of all there would be practically no spring-back to any of the commonly used materials that can be flared, and that if there were any spring-back that it would be practically as much at the base of the flare as it would be at the toe.

XQ. 299. And at the base of the flare there is

(Deposition of Robert Henry Davies.)
really almost no expansion due to the tool; that is right, isn't it?

A. Well, there is no expansion right at the base of the flare, that is right, but I should have said a little short distance up from the base of the flare.

XQ. 300. Isn't is true that the more expansion you get the more spring-back you are likely to get?

A. No; not—that's true as long as you stay within the elastic limit of the material, but once you have achieved the elastic limit of the material, then you get less spring-back than you would if you stayed within it. For instance, you could take a piece of steel and bend it, and as long as you stayed within the elastic limit, it would resume its former shape and you get considerable spring-back, but if you exceeded the elastic limit by bending the steel around your knee to a 90-degree angle, it wouldn't go back at all and you would get practically [204] no spring-back.

XQ. 301. There is something in the middle, though, where you exceed the elastic limit but only a little bit?

A. That is right; but once you exceed the elastic limit it will not return to its original position.

XQ. 302. Well, in commercial practice of making flares, do you always exceed the elastic limit of the material flared?

A. Certainly. Otherwise the flare would spring back and you wouldn't have any flare there. It would be just the same as it was before.

(Deposition of Robert Henry Davies.)

XQ. 303. Well, if you just partially exceeded it, you would get a partial spring-back, wouldn't you?

A. No; you can't partially exceed something. You either exceed it or you don't.

(Discussion, off the record.)

A. (Continuing): Well, my point was that you either exceed the elastic limit or you don't exceed it. If you exceed it, it does not return; if you don't exceed it, it does return.

Mr. Beehler: No further cross-examination.

Mr. Freeman: Mr. Davies, you are willing to waive your signature to the deposition, and I understand that's agreeable with Mr. Beehler? [205]

Mr. Beehler: That is correct.

Mr. Freeman: And it's agreeable to me, so it's all agreed.

Now, this concludes the taking of depositions at Cleveland, and I understand you have your notice and we will see you in New York City on Tuesday morning next?

Mr. Beehler: That's fine.

(Signature waived.) [206]

Certificate

The State of Ohio,
County of Cuyahoga—ss.

I, William E. Ferris, a Notary Public within and for the County and State aforesaid, duly commissioned and qualified, authorized to administer oaths and to take and certify depositions, do hereby

(Deposition of Robert Henry Davies.)

certify that the above-named Frederick E. Amon, Jr., and Robert Henry Davies, were by me, before the giving of their depositions, first duly sworn to testify the truth, the whole truth, and nothing but the truth; that the depositions as above set forth were reduced to writing by me by means of Stenotypy, and were later transcribed into typewriting under my personal direction, and are a true record of the testimony given by the witnesses; that the reading and signing of the depositions by the witnesses were expressly waived by stipulation of the witness and counsel; that said depositions were taken on Thursday, the 5th day of May, A.D. 1949, in the City of Cleveland, County of Cuyahoga, and State of Ohio, pursuant to the annexed notice and stipulations of counsel herein contained; and that I am not a relative or employee or attorney or counsel of any of the parties, or a relative or employee of such attorney or counsel, or financially interested in this action.

In Witness Whereof, I have hereunto set my hand and seal of office, at Cleveland, Ohio, this 18th day of May, A.D. 1949.

/s/ WM. E. FERRIS,
Notary Public.

[Endorsed]: Filed June 22, 1950.

[Title of District Court and Cause.]

NOTICE OF INTENTION TO TAKE DEPOSITIONS

To: Glenn A. Lane, 1151 Los Angeles Stock Exchange Building, Los Angeles 14, California, Huebner, Beehler, Worrel, Herzig & Caldwell, 610 South Broadway, Los Angeles 14, California.

Sirs:

Please take notice that on Tuesday, April 26, 1949, at 10:30 a.m., the Plaintiff in the above-entitled cause will proceed to take the depositions of:

Roland Bergh, Farmingdale, Long Island, New York,

William D. Clark, c/o Republic Aviation Corporation, Farmingdale, Long Island, New York,

W. Howard Ehmann, c/o Republic Aviation Corporation, Farmingdale, Long Island, New York,

Edward M. Greer, c/o Greer Hydraulics, Inc., 454-18th Street, Brooklyn 15, New York,

and perhaps others of whom due notice will be given, in accordance with the Federal Rules of Civil Procedure, before an officer authorized by law to take depositions, at the offices of Cravath, Swaine & Moore, 15 Broad Street, New York 5, New York, when you may attend and cross-examine said witnesses if you see fit so to do.

The taking of the aforementioned depositions will be subject to adjournment from day to day until completed.

Dated this 6th day of April, 1949.

BAIR & FREEMAN,

By /s/ WILL FREEMAN,

By /s/ W. M. VAN SCIVER,

Attorneys for Plaintiff.

[Title of District Court and Cause.]

DEPOSITIONS OF W. HOWARD EHMANN, WILLIAM D. CLARK, EDWARD M. GREER, AND ROLAND BERGH

taken on behalf of the plaintiff in the above-entitled action pursuant to notices dated April 6, 1949, and subsequent stipulation of adjournment to the above time and place.

Appearances:

For the Plaintiff:

MESSRS. BAIR & FREEMAN,
No. 135 South La Salle Street,
Chicago 3, Illinois, by

WILL FREEMAN, ESQ., and
W. M. VAN SCIVER, ESQ.,
Of Counsel.

For the Defendants:

MESSRS. HUEBNER, BEEHLER, WORREL, HERZIG & CALDWELL,
No. 610 South Broadway,
Los Angeles 14, California, by

VERNON D. BEEHLER, ESQ.,
Of Counsel.

STIPULATION

It Is Hereby Stipulated and Agreed, by and between the attorneys for the respective parties hereto that the stipulations heretofore entered into during the taking of the depositions of Frederick Amon,

Jr., and R. H. Davies at Cleveland, Ohio, in the above-entitled causes may apply to the depositions taken in New York City.

PROCEEDINGS

W. HOWARD EHMANN

having been first duly sworn by Irwin T. Shaw, the notary public herein, testified as follows:

Direct Examination

By Mr. Van Sciver:

Q. 1. State your full name and residence. [2*]

A. William Howard Ehmann, 250 Harrison Avenue, Mineola, New York.

Q. 2. By whom are you employed, Mr. Ehmann?

A. Republic Aviation Corporation.

Q. 3. Where are they located?

A. Farmingdale, New York.

Q. 4. What is your position with that company at the present time?

A. At the present it is service manager.

Q. 5. How long have you been employed by Republic? A. Fourteen years.

Q. 6. Will you state the positions that you have held with the company since you started fourteen years ago?

A. Yes. The first few years were rather scattered and varied, from draftsman, assistant to production manager, assistant to factory manager, chief of time study, liaison engineer—in fact, that latter one interspersed the others from time to time.

*** Page numbering appearing at top of page of original Reporter's Transcript of Record.**

(Deposition of W. Howard Ehmann.)
Then, in approximately 1939, I became assistant executive engineer for a period of approximately three years. That was followed by chief service engineer, by assistant service manager, and by service manager.

Q. 7. And your present position is service manager; is that correct? A. That is. [3]

Q. 8. Could you state briefly what some of your duties and work involved? Were you assistant executive engineer?

A. Yes. Generally, it was a matter of contact with the designing forces of the engineering department. The larger part of the job was one of personnel administration, in hiring, firing, and so forth. However, along with that were also other duties, such as the cost control of the designing end of it, which meant that we did have proposals to the Air Forces, all of which had to be priced out; changes that would come on through would also have to be evaluated. All of which did keep me in fairly close contact with the design.

Q. 9. Could you state some of your duties and work in your position as chief service engineer?

A. As chief service engineer, there were several phases of our activity that came under my control. The spare part situation was one; another was handbooks—in other words, the technical orders, operating, maintenance, repair. And the third function was one of corrective action, investigation of unsatisfactory conditions and their correction through the engineering department, recommendations for such corrective action.

(Deposition of W. Howard Ehmann.)

Q. 10. During the war you were the chief service engineer for Republic; is that correct? [4]

A. That's right.

Q. 11. And did you receive any reports concerning unsatisfactory conditions in the field?

A. All reports that came to the company, either through Air Forces channels or through our own service representation in the field, were processed through the Service Engineering Division.

Q. 12. Did you receive reports from all domestic installations—that is, in the United States?

A. Yes, we received unsatisfactory reports—that is, commonly known as URs—from all domestic bases of the Air Materiel Command. In addition to that, we of course had wide coverage through service representatives and regular reports.

Q. 13. How about foreign countries?

A. Because of censorship we did not have the full supply of URs coming on through. However, we did have fair coverage from service representatives.

Q. 14. That was your own service people of Republic?

A. In their letters; and, of course, upon their visits home, we would propose——

Mr. Beehler: May I interrupt for just a minute, and ask you what UR stands for?

The Witness: Unsatisfactory report. [5]

Mr. Beehler: Thank you.

The Witness: Which, incidentally, is an Air

(Deposition of W. Howard Ehmann.)

Materiel Command or Air Forces standard, used by all commands of the Air Forces.

Q. 15. And received by all companies?

A. Yes, that's true.

Q. 16. Now, you became service manager in 1945. Just what was the change-over in the organization, as far as Republic was concerned?

A. May I just correct that? In 1945 I became assistant service manager.

Q. 17. I see.

A. And at that time it was a merger between the Service Engineering Division of the engineering department and the then service department; and in that instance I became assistant service manager instead of chief service engineer. Approximately one year after that I became service manager over the entire installation.

Q. 18. In your work and duties did you have any experience insofar as hydraulic systems and fuel systems on airplanes were concerned?

A. Yes. That was the work of the position.

Q. 19. And are you familiar with hydraulic systems? A. I am. [6]

Q. 20. With Fuel systems, oxygen systems on planes? A. Yes.

Q. 21. Are you familiar with the fittings that were used on those systems? A. I am.

Q. 22. Are you familiar with the AN type fitting? A. I am.

Q. 23. I hand you a drawing which is in evidence as Amon Deposition Exhibit 2, and ask

(Deposition of W. Howard Ehmann.)

you if that is an exemplification of the type of fittings that were used on Republic planes in hydraulic systems and in fuel lines. A. It is.

Q. 24. Is that an exemplification of an AN fitting? A. It is that.

Q. 25. Do you know approximately how many of the fittings, as shown in Exhibit 2, were used on some of the planes which Republic manufactured? First you might give us a few of the types of planes manufactured by Republic during the war, and some approximation of the number of AN flared fittings that were used on some of those planes.

A. The major production of aircraft during the war was the P-47.

Q. 26. How many of those did you manufacture, if that is not confidential? [7]

A. Well, I don't believe it is. Something over 15,000 airplanes. Since that time we have manufactured or produced the F-84.

(Discussion off the record.)

Q. 27. Just approximately how many fittings of the AN type were used on the P-47?

A. Without counting them, I would estimate in the neighborhood of some three hundred on the P-47; more on the F-84. The systems have grown more complex. More systems have been added. And I would say that the F-84 has upwards of 500.

Q. 28. Could you tell just briefly what types of systems, and the things that are accomplished by them, are used on these planes, like the P-47—that is, what does the hydraulic system do?

A. The hydraulic system in the P-47 is actually

(Deposition of W. Howard Ehmann.)

a motivating force for retracting the landing gear and extending the landing gear, for operating the landing flaps, for operating the cowl flaps. Well, I believe that about covers it.

Q. 29. How about the dive brakes?

A. There is no dive brake on the P-47. There was, however, and is on the F-84. On the F-84 you have that added load on the hydraulic system, plus the aileron boost control, [8] which particular control amplifies the pilot's manual force on the stick, to give him a greater force-out at the ailerons for the maneuvering of the airplane.

Q. 30. Did you receive these unsatisfactory reports, the URs, with respect to hydraulic systems?

A. Yes.

Q. 31. And did that include any fitting or tubing failure?

A. There were no URs or reports from service representatives, to my knowledge, which covered the actual fitting. There were, however, unsatisfactory reports and reports from our representatives in the field on the installation of these fittings. In other words, the human element entered into it. It might have been a case of over-torquing of the nut, pulling up too tight, or a case of improperly supporting the line, improperly flaring the tube on assembly of the fitting, either insufficient flare or too large or too thin a flare. And that can happen at any time where you are using soft material of that sort and spin it or press it.

Q. 32. What has been the experience of Repub-

(Deposition of W. Howard Ehmann.)

lic with respect to the AN fittings—that is, on your unsatisfactory reports?

A. Well, from the absence of unsatisfactory reports, and from the fact that we have had no bad experiences with the fittings themselves, I would say that they were entirely [9] satisfactory.

Q. 33. Incidentally, could you tell us whether or not you are an aeronautical engineer? A. Yes.

Q. 34. You are?

A. Yes, a Bachelor of Science in Mechanical Engineering, majoring in aeronautical engineering.

Q. 35. In what college?

A. New York University, Daniel Guggenheim, School of Aeronautics.

Mr. Van Sciver: I think that is all.

Cross-Examination

By Mr. Beehler:

XQ. 36. Mr. Ehmann, during the period wherein you received reports, UR reports, on the AN fitting, were the 811 series fittings used also by Republic?

A. They preceded it. If I remember rightly, they preceded——

XQ. 37. Do you recall when you stopped using the 811 series?

A. I believe it was approximately 1943—in there somewhere; I can't be certain of my dates.

XQ. 38. What were the UR reports, if any, that came in in relation to the 811 series fittings?

A. I believe in the case of leakage. [10]

(Deposition of W. Howard Ehmann.)

XQ. 39. Can you recall what particular face of the fitting received the complaint that made the leakage?

A. I believe it was the pipe thread on it.

XQ. 40. Since your acquaintance with the use of fittings by Republic aircraft, have there been any triple fittings used other than either the 811 series or the AN series?

A. I know of none.

XQ. 41. With respect to either the 811 series or the AN series, have any of the UR reports been concerned with the locking of the sleeves in the nuts? A. I have seen none.

Mr. Beehler: That is all. No further questions.

Mr. Freeman: Are you willing to waive your signature to this deposition, if it is agreeable also to Mr. Beehler, counsel for the defendants?

The Witness: I am.

Mr. Beehler: That is satisfactory.

(Whereupon, at 10:50 a.m., the taking of the deposition of W. Howard Ehmann was concluded.)

SIGNATURE WAIVED. [11]

WILLIAM D. CLARK

having been first duly sworn by Irwin T. Shaw, the notary public herein, testified as follows:

Direct Examination

By Mr. Freeman:

Q. 1. Will you please state your name?

A. William D. Clark.

Q. 2. Where do you reside?

A. 115 Clinton Avenue, Mineola, New York.

Q. 3. By whom are you employed?

A. Republic Aviation Corporation.

Q. 4. And when did you commence your employment with that company?

A. July 21, 1939.

Q. 5. In what capacity were you first employed?

A. Draftsman in the engineering department.

Q. 6. Is that with respect to any particular type of drafting work in the engineering field?

A. Yes. That was in the landing gear group, in the hydraulic section of the landing gear group.

Q. 7. What is meant by "landing gear" with respect to planes?—just for the purpose of the record. [12]

A. Well, that would be the wheels and the shock-absorbing mechanism attached to the wheels to absorb the shock on landing after coming down from being airborne.

Q. 8. Then the landing gear is that structure, including the wheels, upon which the plane lands from a flight? A. That's right.

(Deposition of William D. Clark.)

Q. 9. And the landing gear structure is the mechanism that is sometimes moved inwardly within the body portion or the wing portion of the plane, so as not to interfere during flight?

A. That's right. It's usually retracted after takeoff, and extended for landing.

Q. 10. And what is the mechanism, just briefly, by which the landing gear is retracted or let down and moved back up into the plane proper?

A. There is a landing gear hydraulic retracting cylinder which is operated by the hydraulic system through a selector valve. This selector valve, of course, is in the aeroplane so you can select up or down on the gear.

Q. 11. And this selector valve is under the control of the pilot? A. That's right.

Q. 12. And the landing gear mechanism and the structure by which it is retracted—that is, let down or raised—is [13] operated through the instrumentality of hydraulics? A. That's right.

Q. 13. In other words, hydraulics is the motivating force? A. That's right.

Q. 14. How long were you in the engineering department as a draftsman in the landing gear group of Republic Aviation Corporation?

A. I was in that group about two years.

Q. 15. That would bring it to about 1941?

A. About '41.

Q. 16. In 1941, or after you left the engineering department as a draftsman, what department did you go into?

(Deposition of William D. Clark.)

A. I went to work for Mr. Bergh, who was then chief hydraulics engineer, as head of the engineering research laboratory, the hydraulic end of it—in other words, the hydraulic research laboratory.

Q. 17. And what was your particular work then in the hydraulics lab?

A. I was charged with the testing of hydraulic cylinders, landing gears, valves, and all of the components that go into a hydraulic system, to prove their worth, whether they were good or bad, or of good design or of bad design, and so forth. [14]

Q. 18. While in the hydraulics lab did you have occasion to test the equipment under conditions simulating that which might be involved in an actual airplane?

A. That was one of the functions of the laboratory. We had to make parallel installations in the laboratory—the same as it would be in the airplane.

Q. 19. What do you mean by "parallel installations"?

A. Well, an installation similar to the aircraft installation.

Q. 20. In other words, comparable?

A. Comparable. And prove that out in the laboratory before we flew it, if possible?

Q. 21. And in the hydraulics lab what was your practice with respect to simulating flight conditions? Did you just proceed as you might in a flight, or did you proceed to test at excess pressures?

A. Well, in the laboratory we always would operate at airplane operating pressures. We would

(Deposition of William D. Clark.)

load the gears with lead weights to simulate the air loads that might be encountered in flight, to make sure that our pressures and our equipment were adequate to raise and lower the gears under those flight conditions, and all cylinders and tubing, and so forth, had to be pressure tested to a specified Air Force specification of a proof pressure which was above your [15] normal operating pressure. And then it also had to be tested up to an ultimate burst pressure to determine whether or not the design was practical and was meeting specifications.

Q. 22. You mentioned tubing in your last answer. Is that the tubing by which the hydraulic fluid is transmitted from one source to another source?

A. That's right.

Q. 23. How were these tubes connected up to the control mechanism at one end and the instrumentality, which was to be operated, at the other end? What was used to make that connection?

A. Well, we used the flare tube and nut, sleeve, and fitting, which I believe you call the Parker fitting.

Q. 24. Now, you said "flared tube."

A. Flared tubing.

Q. 25. Just for the record, that is a flare, somewhat funnel shaped, formed from one end of the tube? A. That's right.

Q. 26. And then, on that tube you said there was a Parker fitting or Parker type fitting, comprising a nut, body, and sleeve? A. That's right.

Q. 27. And through the instrumentality of the

(Deposition of William D. Clark.)

nut, body and sleeve—you correct me if I misstate it—the tube was [16] actually connected up to the instrumentality to be operated?

A. That's correct.

Q. 28. And I take it the same thing existed at the opposite end of the tube where you had a selector control or valve as in the case of your retractable landing gear?

A. That is correct. Each tube assembly had two fittings on each end—one on each end.

Q. 29. In this testing department that you were in as early as 1941, how long were you in that particular division of your company?

A. I was in there about up to 1943, I think it was—about two years.

Q. 30. When you simulated, as you have testified, the operating conditions of the plane, particularly in the hydraulics field, did you have occasion to use the Parker type fittings in your test laboratory?

A. We used them entirely, in fact, in the laboratory. We had no other type.

Q. 31. When you say "We used them," does that mean that you personally had occasion to use them? A. That's right.

Q. 32. In other words, you did the manual or physical work in connection with making up these tests? A. That's correct. [17]

Q. 33. In other words, the get-ready?

A. That's right.

Q. 34. Were these fittings used once and dis-

(Deposition of William D. Clark.)

carded, or what are the facts with respect to the fittings?

A. No. Usually in the laboratory we would have certain stock fittings that were designated for the laboratory; and we would use the same fittings probably over and over and over again in all different sizes. We had a stock of fittings in about six or eight different sizes. And those fittings were used not on one test but in several tests, as long as the fitting was usable. By that I mean if somebody hadn't knocked the threads when tightened by the wrench, or something like that, the same fittings we used probably five or six hundred times.

Q. 35. On the different flares?

A. On the different flares, the different tubings, the different units, and so forth.

Q. 36. So the fittings were in fact re-used and used over again? A. That's right.

Q. 37. Did you require as good a fitting, after they were used a dozen times, as when you were making the first installation with the fitting?

A. Oh, yes. [18]

Q. 38. And what was your experience with the re-use of the Parker type fitting? How did they stand up? What did they do?

A. They stood up very well. Of course, we were more apt to use steel fittings of this type than aluminum fittings, due to the fact that after the test you would throw a fitting back in the stock drawer, and aluminum, of course, or Dural would have the threads buggered out or scratched, and the flare

(Deposition of William D. Clark.)

would be scratched. So we used a lot of steel fittings for the simple reason that they didn't score up so easily under laboratory conditions. Of course, there they got very hard usage. But they were always satisfactory up to the point where some physical damage would occur by mishandling.

Q. 39. And that was proper use of the fittings which permitted their re-use many times?

A. That's right.

Q. 40. In connection with these tests that you made on hydraulic cylinders, and the like, where you used tubes and fittings of the kind here involved, which would burst first—the cylinder or the fitting? In other words, which would give way first?

A. Well, in all cases when you are going to make a test of that type, of course, you pick the proper size of [19] fitting and the proper wall tubing. When you are running a burst test, you design for the cylinder to go to its maximum without any breakage on other components, and the cylinder would always go first.

Q. 41. In other words, the fitting, including its gripping or retaining of the flare of the tube, would stay put—using that language—and would so stay even though the hydraulic cylinder might burst?

A. That's correct; that's right.

Q. 42. You were talking a minute ago about the hydraulic cylinders bursting. Can you give me the range of pressures which were used when you made tests—that is, pounds per square inch?

A. Yes. We operated at that time on a one

(Deposition of William D. Clark.)

thousand pounds per square inch hydraulic pressure, and we had a proof pressure on the cylinder of 1,500 pounds. Then we had a burst pressure of 2,500 pounds.

Now, the 1,000-pound system—tubing, fittings, cylinders and valves, and so forth, should not fail below 2,500 pounds, although we were only operating normally at 1,000 pounds. And I remember on the P-47 main landing gear—the nomenclature is now F-47—the burst pressure on those ran up to 4,500 PSI before the cylinder burst. That's pounds per square inch. So we had a good margin of safety on that. [20] At that time the fitting and the tubing held up to that pressure, and the cylinder was the first to fail.

Q. 43. You mentioned the P- or F-47. That was a plane manufactured by Republic Aviation for the Government? A. That's correct.

Q. 44. And were the Parker type fittings used in those planes? A. Yes. They were.

Q. 45. To your personal knowledge?

A. Yes, they were.

Q. 46. Do you have any estimate with respect to the number of fittings of the kind here involved that were actually used in a P-47?

A. Well, of course, they were used in several systems. I would say probably 350 to 450—around there somewhere.

Q. 47. In other words, if you had, say just in rough numbers, 300 fittings, that would mean you were coupling at least 150 tubes?

(Deposition of William D. Clark.)

A. That's correct, yes.

Q. 48. In other words, fittings usually are twice as many as tubes?

A. That's right; one tube assembly amounts to two fittings and one tube.

Q. 49. That is the usual arrangement. There might be [21] certain exceptions in cases of that kind? A. That's right.

Q. 50. And I am correct, am I not, that your company manufactured P-47s by the thousands?

A. Yes. I think we finally ended up at the end of the war with about 15,000 airplanes?

Q. 51. Now, you have carried us up to about the early part of 1943, while you were in charge of the hydraulics testing in the hydraulics lab. Did you continue to stay in that department, or what was your next step in the company?

A. After I was in the lab, I went over into service liaison engineering. I was a service liaison engineer, which consisted of close liaison between the engineering department and the service department. In that capacity, as failures would be reported from the field on operational aircraft, which were failures due to some engineering or bad installations in production, and so forth, it was my job then to advise the engineering department of such failures and try and get those things corrected on airplanes in production at that time so that the same failure would not recur again on subsequent aircraft.

Q. 52. In other words, you translated what happened out in service back to engineering?

(Deposition of William D. Clark.)

A. That's correct. [22]

Q. 53. So that the corrections might be made?

A. I was more or less in the hydraulic end of it, the hydraulic specializing end of it. I think we had several service liaison engineers at the time. I have been from that time on, when I left the hydraulic laboratory, more or less of a hydraulics specialist; I have specialized in aircraft hydraulics.

Q. 54. So even while liaison engineer between service, on the one hand, and engineering on the other, you were still specializing in hydraulics?

A. That's correct.

Q. 55. And in the kind of hydraulics that had to do with the landing-gear mechanism and the flap-operating mechanism? A. That's right.

Q. And is it also true that as a liaison engineer you just carried on that which you were in fact doing while with the test laboratory?

A. That's correct—only not in the manual manner which I worked in the laboratory.

Q. 56. Is it fair for me to say that as a liaison engineer you were coordinating service problems with engineering? A. That is correct, yes, sir.

Q. 57. Now, are you still in that department?

A. Well, that department was consolidated, I believe. [23] At that time service engineering came under the service department, but it was a little disconnected, and they made a clarification of the job and designated it as a definite function of the service department.

I went then into the service department, in which

(Deposition of William D. Clark.)

I had been more or less at the time as a service engineer. I believe that was about a year or so later, when I first went in.

Q. 58. In other words, you were a liaison engineer about a year? A. That's correct.

Q. 59. Thereafter, your work there was consolidated with service and service engineering?

A. That's correct.

Q. 60. And have you remained in that——

A. I remained in the service department until about 1943 or '44, and then I went back into engineering to design the F-84 hydraulic system. At that time there didn't seem to be any competent hydraulic—I don't say "competent"—but probably any man free to design the F-84 hydraulic system.

Q. 61. When you say "any man free," you are referring now to the people employed by Republic Aviation?

A. That's correct—and by their own engineering department as hydraulics men or hydraulics designers. So I actually [24] transferred back into engineering from the service department; and for a period of about a year and a half I was working on the design of the hydraulic system for the F-84.

Q. 62. And the F-84 is a plane that is just now——

A. It is at the moment in production by Republic.

Q. 63. And that plane employs the hydraulic system which you designed for its use?

A. That is correct, sir. Much more complicated, however, than the F-47 system.

(Deposition of William D. Clark.)

Q. 64. In other words, the hydraulics were much more complicated? A. That's correct.

Q. 65. The problems were a little tougher?

A. Much tougher.

Q. 66. Now, let me hand you an exhibit drawing which has been marked Plaintiff's Exhibit No. 2 (Amon deposition), and I will ask you to look at it and tell me whether you recognize that as a Parker type fitting?

A. Yes, that's a Parker type, correct.

Q. 67. Now, you testified that these fittings required assembly and disassembly while you were in the testing laboratory. Is it likewise true that they require assembly and disassembly in actual plane installations?

A. Yes, they do. Of course, they aren't assembled and [25] disassembled as much. Once they are installed in the airplane, unless something goes wrong with an operational unit, why, the unit has to be removed and replaced by another unit.

Q. 68. So that when you say an operating unit or an operation unit, if something goes wrong with it, that requires a substitution or a new unit to replace it, which necessitates disconnecting the tube leading to that unit through the medium of the fitting; correct? A. That's correct.

Q. 69. And then that fitting is re-used with the new unit that is installed in place of the unit that has been taken off? A. That's correct.

Q. 70. And I take it that you require the same precision fitting or characteristics of the fitting when

(Deposition of William D. Clark.)

you install the new unit as was required when the old unit was in use? A. That's right?

Q. 71. In other words, pressures are the same and operating conditions are substantially the same?

A. That's correct.

Q. 72. I call your attention to the sleeve on Plaintiff's Exhibit 2 (Amon deposition), and will ask you if there is any advantage in providing an angle on that sleeve so that it tapers from its heel towards the nose? [26]

A. You mean this external angle here (indicating)?

Q. 73. Yes.

Mr. Freeman: Let the record show the witness has pointed to the external angle marked "sleeve head angle."

A. Yes, that's quite important. In fact, if that angle wasn't there, much as shown, the nut might have a tendency to gall on the nut itself. The sleeve in the nut would have galling between the sides of the sleeve. But I remember that its main function, from the way it was used, was to give it hoop tension. It gives it hoop tension whereby, when the nut is tightened up on the fitting, this lower end of the sleeve is allowed to flex out without the end of the sleeve gouging into the flare on the tube. It gives the sleeve a certain amount of flexibility under its compression load from the nut. It prevents the scoring or the lining of the tube flare so it doesn't imbed itself in the tube flare.

Q. 74. Now, just so the record is straight, when

(Deposition of William D. Clark.)

you talk about tightening the nut, you are now talking about the member illustrated on Plaintiff's Exhibit No. 2 (Amon deposition) as the "nut"?

A. That's right. I am talking about this nut right here (indicating), which pulls up against the sleeve and pulls the flare against the fitting.

Q. 74. And where is the engagement between the nut and the [27] sleeve?

A. That would be on the shoulder of the sleeve and the shoulder of the nut, where we would get our engagement between the sleeve and the nut. It would be on the shoulder of each.

Q. 76. And those parts are marked on Plaintiff's Exhibit No. 2 (Amon deposition) "sleeve shoulder" and "nut shoulder"; correct?

A. That's correct.

Q. 77. Now, as the nut is brought home or put under load, did I understand you to say that the lower end or the nose end of the sleeve springs slightly outwardly or is put under tension?

A. That's correct.

Q. 78. Is that what you meant by "hoop tension"?

A. That is what I meant, yes; so you could get full surface contact of the inside sleeve angle against the flared tube; so you would get full surface contact and not just point contact of this edge here of this sleeve. It allows it to move out and get full surface contact rather than just point contact.

Q. 79. And the movement is greater, or the expansion is greater at the lower end of the sleeve than at the region of contact or the shoulder?

(Deposition of William D. Clark.)

A. That's right. This section at the lower end, of course—the section through there (indicating)—is much smaller [28] than the section through your shoulder, so that under load, and especially on a conical surface such as this where you would pull down and it would tend to move out, expand out, so that it will be allowed to expand out and engage on a full surface.

Q. 80. So that you get the necessary gripping contact between the sleeve and the flare to insure a proper fitting?

A. That's right—surface engagement.

Q. 81. And as you have said, that is because of the angle on the outside of the sleeve?

A. That is correct.

Q. 82. Now, when you have the expansion or extension, using any term that you have just mentioned, what would happen if the sleeve actually galled the inside of the nut when you disassembled the parts?

A. Well, if this angle wasn't there, if the sleeve angle wasn't there, when you pull down on there and this did expand or move out, the sleeve moved out, you would get galling between the sleeve and the nut; and when the nut was removed, or when you wanted to take the fitting apart, this sleeve would turn with the nut, in turn scoring the tube flare, grooving the tube flare and actually ruining the tube. You would have to replace it because of bad scoring. And that also relieves that condition, by having that sleeve head angle [29] in there.

(Deposition of William D. Clark.)

Q. 83. In other words, it is desirable to permit the nut to be removed with respect to the sleeve without it actually rotating the sleeve on the flare?

A. That's right.

Q. 84. Now, you mentioned scoring, and you said the tube couldn't be reused. Is there any danger or any hazard brought about by scoring of the tube?

A. Yes, definitely. When the flare is scored or grooved, that offers a potential failure at that point, the same as cutting through the tube or through the flare. Under pressure pulsations this scoring would become greater and greater until you would get a subsequent failure of your tube flare.

Q. 85. By "potential failure," do I understand that that is setting up a condition which ultimately may bring about a hazardous condition?

A. That is correct—a tube failure with subsequent loss of hydraulic fluid and an emergency condition being presented as far as the hydraulic system is concerned.

Q. 86. So that it is desirable to make the installation or reinstallation, when the fitting is reused, without scoring or marring the flare itself?

A. Whenever we have a tube, a fitting taken apart and [30] a new unit put in the system, that is one of the points of inspection—that the tube flare shall always be reinspected before assembly of the new unit.

Q. 87. So that if in the event it is scored, that tube and the flare thereon is no longer reusable?

A. That is correct.

(Deposition of William D. Clark.)

Q. 88. So that the removal of the nut, which is necessary when you separate a fitting, must not jam with the sleeve? A. That's right.

Q. 89. Now, you used the word "gall." Do you mean that the sleeve and the nut rub against each other, or score or mar or scratch?

A. That's right—it is a mark due to friction, a score-mark due to friction on tightening.

Q. 90. That's really excessive friction?

A. That's excessive friction.

Q. 91. If the nut jams with the sleeve, then the friction or the scoring takes place between the sleeve and the flare of the tube?

A. The tubing.

Q. 92. And that in turn, if such does happen, precludes the tube from being reused?

A. That's right.

Q. 93. Or if reused, sets up a potential hazard or potential [31] failure?

A. A potential hazard. If it isn't discovered, it may be reused; and if it's reused, you have a point of potential failure.

Q. 94. Is it desirable that the nut shoulder and the sleeve shoulder overlap as much as possible?

A. Oh, yes, that's very necessary.

Q. 95. Is that to give the necessary strength to the parts, one with respect to the other?

A. That's right. If you only had hairline contact between the shoulder of the nut and the shoulder of the sleeve, your sheer section through the nut shoulder would be less; your centering character-

(Deposition of William D. Clark.)

istics of the sleeve in regard to the nut when pulled down on the thread would be less; and your compression area would be less, which is dangerous under high pressures. You want as much thickness through there as possible and as much engagement between the sleeve nut and the sleeve as possible, without too much weight, of course.

Q. 96. Did I understand you to say "without too much weight"?

A. Well, that has to be considered in aircraft, of course. We can't be putting in fittings over-sized, sections that are over-sized. That comes in the design of any part of aircraft—that weight is a definite factor. [32]

Q. 97. As you say, it is desirable to have the maximum contact between the sleeve shoulder and the nut shoulder, but you still want to permit the nose end of the sleeve to swing outwardly in order to get hoop tension without affecting the shoulder contact? A. That's right.

Q. 98. And does the fitting that is exemplified by Plaintiff's Exhibit No. 2 (Amon deposition), the Parker type fitting, do just that?

A. Yes, I would say it did.

Q. 99. Now, the statements that you have made and the explanations that you have here made, have been from your actual experience and knowledge in the use of these fittings?

A. That's correct, sir; yes, sir.

Q. 100. What might happen if there is in fact some scoring between the sleeve shoulder and the

(Deposition of William D. Clark.)
nut shoulder? Is that hazardous or does that set up any potential failure?

A. Well, it would, on assembly and disassembly, because the sleeve would rotate with the nut, in turn scoring the tube in one case; and in fact that's the prime factor of having the nut rotate on the sleeve and the sleeve not rotate on the tube.

Q. 101. However, if there was some scoring between the shoulder of the nut and the shoulder of the sleeve, would that [33] in any way impair the actual fitting from functioning as a sealing member?

A. No.

Q. 102. And there would not in fact be any real hazard set up due to that type of scoring?

A. No, there would be no hazard there.

Q. 103. As I understand it, where you have to keep away from scoring is on the tube proper?

A. That's right.

Q. 104. Adjacent to the flare?

A. That's right; there should be no rotation between your sleeve and your tube; the rotation should be only between your nut and your sleeve.

Q. 105. Now, you mentioned hairline contact or narrow contact between the sleeve shoulder and nut shoulder. Is there any advantage with respect to spreading the friction between the nut and the shoulder of the sleeve over a greater area by having maximum contact?

A. Yes, there is. Of course, now, with hydraulic systems we get into a little different condition than we do with, let us say, an oxygen system where the

(Deposition of William D. Clark.)
same fittings are used. In an oxygen system there can be no oil adjacent to the fitting or on the fitting. In a hydraulic system you have oil. As a rule, you have to lubricate your units with [34] hydraulic oil and flush them before installation. In a hydraulic system there would be oil present between the nut and the sleeve when installed, and that gives us an ideal condition as far as friction is concerned between the nut shoulder and the sleeve shoulder. But now I speak of the oxygen system, where there can be no oil whatsoever. The nut and the sleeve are of two different materials. When you have two different materials in friction, the wider surface you have the less possibility you have of the harder material embedding itself into the softer material. In the case of this fitting here, you have two different materials, and it is necessary to have as wide a contact as possible at the point of engagement.

You see, there are several different conditions you have to meet; and in all cases, regardless of whether the fitting is oiled or not oiled, the wider surface contact you have between the sleeve and the nut, the more desirable it is.

Q. 106. Are you familiar with the type of fitting wherein the sleeve has a double angle, or what is sometimes called a differential angle, between the inside of the sleeve and the outside of the flare?

A. Yes.

Q. 107. And have you used such fittings?

A. Yes, we have used those, too.

(Deposition of William D. Clark.)

Q. 108. Does that bring about contact between the flare and [35] the nose end of the sleeve first?

A. Would you mind putting that question to me again?

Q. (Q. 108 read by reporter as recorded.)

A. Yes.

Q. 109. And as the nut is tightened or put under more torque, the space between the sleeve and the outside of the flare diminishes?

A. That's right.

Q. 110. So that you go from what might be called a narrow or line contact to a greater or surface contact?

A. Surface contact, that's right, with a little bit more flexibility than you have in the other one.

Q. 111. And when you said "with a little bit more flexibility than you have in the other one," you were then referring to the type shown in Plaintiff's Exhibit No. 2 (Amon deposition) as "the other one"; correct? A. That's correct.

Q. 112. In other words, if you over-torqued the type of fitting as shown in Plaintiff's Exhibit No. 8 (Amon deposition), what would happen—a small amount of over-torquing?

A. You would probably get some embedding in the tube flare itself.

Q. 113. In other words, the sleeve would embed somewhat in the tube flare? [36]

A. That's right.

Q. 114. But would that bring about any hazard-

(Deposition of William D. Clark.)

ous condition?

A. Not unless it was done several times—reassembled and disassembled.

Q. 115. In other words, the differential angle gives you a little bit of flexibility?

A. That's right; it gives you more flexibility on installation.

Q. 116. So you can over-torque? A. Yes.

Q. 117. Of course over-torquing to the extent of ruining the fitting or the flare would be just too bad?

A. That's right; but it isn't as bad with this two-angle fitting or two-angle sleeve. In fact, in my experience, it's a much better sealing medium.

Q. 118. In other words, it gives you line contact or narrow contact first, and then greater——

A. And greater surface contact.

Q. 119. When you say from your experience, I then take it that you have actually observed the operation of fittings of the kind shown in Plaintiff's Exhibit 8 (Amon deposition) and have actually used them? A. That's correct.

Q. 120. You have used them both in the testing laboratory [37] as well as observing their operating characteristics as an engineer, and have seen them in use on planes? A. That's right.

Q. 121. Now, while you were in the service engineering, did you get any reports with respect to the operations of planes involving hydraulic systems?

A. Yes, that was my function in the service department as the hydraulics specialist, let us say.

(Deposition of William D. Clark.)

During the war all of the unsatisfactory reports that came into the service department from the using activities were separated in their different categories as power plant, hydraulics, fuel, armament, and so forth; and all of the hydraulic URs, as we called them—unsatisfactory reports we call "URs"—were handed to me to find out what caused the failure, whether it was the fault of manufacture or whether it was the fault of a material failure, to determine whether it was due to misuse by the using services, and determine the cause, corrective action to be taken, and answer that UR to the Air Materiel Command to their satisfaction.

Q. 122. You said these reports came to you. Were those reports only from the United States, where planes were based?

A. No, those were overseas reports and field of combat, as well as domestic reports here in the United States.

Q. 123. In other words, anything that was unsatisfactory [38] with respect to hydraulics, either in this country or abroad or in combat zones—that information, when it came back to Republic Aviation, came to your attention? A. That's right.

Q. 124. And you were to do something about it?

A. That's correct.

Q. 125. Again, those reports that were brought to your attention related specifically to the hydraulics? A. That's right.

Q. 126. What was your experience over the war period, or the period that you were operating in the

(Deposition of William D. Clark.)

service engineering division, with respect to Parker-type fittings of the kind that are here exemplified by Plaintiff's Exhibits 2 and 8 (Amon deposition)?

A. As I remember it, we had very few fitting failures. By "fitting," I am talking about the assembly itself—the nut, the sleeve. I presume that is what you mean by the fitting—you mean the whole assembly?

Q. 127. You tell us what you have been testifying to as a fitting, and that will be better.

A. Well, taking the whole thing; as a rule, when we mention "fitting" we mean the whole assembly, and not the sleeve and the unit that goes into the operational unit and the tubing flare. [39]

Q. 128. In other words, the parts that are exemplified on the drawings that you have in front of you, Plaintiff's Exhibits 2 and 8; correct?

A. That is correct, yes. We have had some people that call "fittings" just the part that screws into the operational unit and disregard the nut and sleeve. Naturally, the nut and sleeve are part of the fitting. I just wanted to get that clarified.

Q. 129. And in all of the testimony that you have been giving here you have been talking about a fitting in the sense as illustrated in Plaintiff's Exhibits 2 and 8? A. Yes, that's right.

Q. 130. All right, proceed.

A. As I remember it, as far as the fitting failures are concerned, we did have some. I think there were about eight or nine tube flare failures. There were a couple of sleeves that split. And we did have

(Deposition of William D. Clark.)
somewhere, when the nut was installed on to the fitting which goes into the operational unit, it was cross-threaded and installed that way, and when disassembled, of course, it was bad. But the majority of the tubing failures or flare failures I ran down to be nothing more than poor flares to begin with—flaring more one side of the tube than the other with improper flaring tools.

The split sleeves—we did get one exhibit back on [40] a split sleeve, and we discovered that the sleeve had been scored prior to installation, and under pressure pulsations—maybe thousands of pressure applications—had slowly failed up to the point where it failed.

On these nuts being cross-threaded on the fitting and the operational unit—that is something that during the war we had no control over, as far as some of the mechanics that were employed.

Q. 131. Your company used literally millions of these fittings?

A. I would say so, yes. In 15,000 airplanes—we used them in about four different systems, and we used a lot of them in the hydraulic system itself—I would say we didn't have more than fifteen or sixteen failures, maybe.

Q. 132. So percentagewise, that was a very small amount? A. I would say so.

Q. 133. When you went into the service engineering department, who was your immediate superior?

A. Mr. Hlavac. Actually I worked for Mr. Hlavac, whose immediate superior was Mr. Ehmann.

(Deposition of William D. Clark.)

Q. 134. So that you were in Mr. Ehmann's department, and that is the Mr. Ehmann who is sitting in the room with us at this moment?

A. That's right. [41]

Q. 135. Now, the tubes and tube couplings or the fittings of the kind that you have been testifying about, when used in planes, are in many cases used in cramped quarters or confined spaces?

A. That's very true.

Q. 136. And does that increase the problem of assembly? A. Definitely.

Q. 137. And I take it likewise with disassembly?

A. That's correct.

Q. 138. And are there instances where the tube is bent at an angle closely adjacent its flared end?

A. In many cases, yes; in many cases.

Q. 139. So that it is desirable, then, when removing the part, to have the nut separate from the sleeve so that you can go around the bend?

A. That's right.

Q. 140. What would happen if the nut and sleeve were jammed or were made out of one piece? Could you then go around that bend?

A. No, it would be impossible.

Q. 141. So that it is desirable, and actually a necessity, to have the parts so cooperate as to permit easy disassembly of the nut?

A. That's right. [42]

Q. 142. Now, you are testifying about that from actual experience?

A. That's from actual experience, yes, sir.

(Deposition of William D. Clark.)

Q. 143. From actually seeing and doing?

A. Both.

(Discussion off the record.)

Cross-Examination

By Mr. Beehler:

XQ. 144. Mr. Clark, will you tell us your age, please? A. 38.

XQ. 145. You mentioned, Mr. Clark, the testing of Parker-type fittings in the hydraulics research laboratory. I believe you used the expression. Were they all fittings of Parker manufacture, or were there fittings of other manufacture also?

A. Back at that time we were purchasing practically—As I remember it, at that time a majority of them were from Parker, but it is very possible that some of them were coming from other manufacturers. I am not well versed in the procurement end of it. But they were all similar, all the same as far as design is concerned.

XQ. 146. So far as you knew, then, they might have been Parker fittings, or they might have been somebody else's fittings; isn't that right? [43]

A. As far as the manufacture of them is concerned, yes.

XQ. 147. With respect to those fittings, were they all AN standard fittings, or were some of them AC-811 Series fittings?

A. At the beginning they were all AC-811, which was known as the AC or AN-811 fittings. It is now AN-811; at that time it was AC-811.

(Deposition of William D. Clark.)

XQ. 148. During that period of testing was there ever brought to your attention a fitting difficulty with respect to the AC-811 Series fittings wherein, when the fitting was uncoupled, the sleeve stuck in the nut?

A. Yes, there was. At the very beginning of my experience in the laboratory we did have some trouble with the sleeve sticking in the nut.

XQ. 149. And were they Parker-type fittings?

A. They were Parker-type, yes.

XQ. 150. Were they fittings of Parker manufacture?

A. That I couldn't say, whether they were manufactured by Parker or somebody else.

XQ. 151. However, they were the AC-811, I believe you said? A. That's correct.

XQ. 152. In the hydraulic testing which you did —those testing systems which were, I believe you mentioned, parallel [44] to conditions which existed in planes—— A. Yes.

XQ. (Continuing): ——did you test for the entire hydraulic system, including making tests on the fittings as well as the rest of the systems?

A. Yes.

XQ. 153. Did you make any express tests on fittings?

A. We did run a series of tests on flares and fittings to prove the fitting itself.

XQ. 154. Did you make breakdown tests on fittings?

A. That's correct—testing the flares themselves

(Deposition of William D. Clark.)

to make sure the flares and the fittings were going to be as leak-proof as possible and to withstand the pressures to which they would be subjected, yes, sir.

XQ. 155. How high did you go on pressure-testing the fittings?

A. We have gone as high as 10,000 pounds per square inch.

XQ. 156. Did you find fitting failures at that pressure?

A. No fitting failures, but we did have tube bursting failures; that was the stainless steel tube, and the tube would always burst before the flares would pull from the fitting.

XQ. 157. That was what pressure, did you say?

A. 10,000 pounds per square inch. [45]

XQ. 158. How much safety factor does that give?

A. We based our calculations on 1.5 operation pressure, one and a half times your operation pressure on fitting design, as far as going from a dural fitting to a steel fitting. A fitting shouldn't fail. The flare shouldn't blow from the sleeve below two and a half times your operational pressure.

XQ. 159. And the operational pressures which you mentioned in connection with those tests were how much?

A. The tests that we normally ran in the laboratory were at 1,000 pounds per square inch.

XQ. 160. So that a safety factor of two and a half would have been twenty-five hundred?

A. Twenty-five hundred pounds per square inch

(Deposition of William D. Clark.)
would be your safety factor, which is normally, you figure, your burst pressure.

XQ. 161. Then with the 10,000-pound test, you were what—six times over the safety factor?

A. Well, in that test, in the thousand-pound operation, we were using dural fittings. When we were going to the burst pressures, to burst operational units, to find their burst points, we would use a steel fitting, a steel nut, with stainless steel tube, and possibly double flare with the stainless steel tubing. We figured on a safety factor of 10,000 pounds at one and a half, so that we could carry the fitting and the [46] tubing up to 15,000 pounds per square inch; and we had calculated that the unit should burst at 8,000, but it carried on to two more thousand PSI. But we wouldn't have gone above 12,000 with the safety factor giving us fifteen—we wouldn't have gone above 12,000 if the unit hadn't burst at that point.

XQ. 162. Actually, then, isn't it true that if the fitting was capable of standing, let us say, 6,000 pounds, it would have been amply safe for the installation that you were then concerned with?

A. Are you referring to this burst test we were running, or the normal operational?

XQ. 163. The normal operational of the hydraulic system. A. With the dural fitting?

XQ. 164. Yes.

A. Oh, yes; 6,000 would have been satisfactory, although possibly a little heavier than necessary.

XQ. 165. Now, I direct your attention, Mr.

(Deposition of William D. Clark.)

Clark, to Plaintiff's Exhibit No. 2 on the Cleveland deposition. I believe that in your direct testimony you referred to the sleeve as springing outwardly to allow full surface contact. That's correct, isn't it? A. That's correct.

XQ. 166. You also had your attention called on the same exhibit to an angle on the exterior of the head of the sleeve, [47] labeled on the exhibit "sleeve head angle." A. That is right.

XQ. 167. Is it true that that angle is necessary in order to permit the sleeve to spring outwardly to allow full surface contact?

A. You would need a thinner section at the bottom than you do at the top to allow more flexing on the bottom on an inclined plane, to get flexing out of your sleeve.

XQ. 168. Suppose in that particular exhibit drawing, instead of having the sleeve head angle there indicated, you had a clearance of a corresponding amount. Would not the sleeve spring outward also under those conditions to allow full surface contact?

A. Do I interpret that question correctly? Do you mean a clearance around the entire circumference of the sleeve, a constant circumference from the top to the bottom?

XQ. 169. Yes, so that the exterior would be cylindrical instead of frusto-conical.

A. Well, then, you would possibly get bending also at the point where the leg of the sleeve meets

(Deposition of William D. Clark.)

the L-section at the corner, the thin section of the sleeve.

XQ. 170. You are referring to the thin section adjacent to the sleeve shoulder and the nut shoulder junction; is that right? [48]

A. That's right, yes.

XQ. 171. Did you ever see a sleeve bend at that point?

A. No; that would take a sectioning of the sleeve and actual microscopic examination of the material at that point.

XQ. 172. Your answer is purely hypothetical?

A. Purely hypothetical as far as that is concerned.

XQ. 173. Now, I believe you also said, Mr. Clark, in your direct testimony, that there was necessary as much surface contact as possible between the portion labelled "sleeve shoulder" and the portion labeled "nut shoulder"? A. That's right.

XQ. 174. Suppose that contact on the drawing before you were reduced by an overall of four-thousandths of an inch. Would you still have a good coupling, do you think?

A. Is that four-thousandths on the——

XQ. 175. On the diameter.

A. On the diameter. That's two on the radii: right?

XQ. 176. That is right.

A. It is possible it would be satisfactory, but that is a stress engineer's tear-out analysis, and I wouldn't state whether it would be satisfactory or not.

(Deposition of William D. Clark.)

XQ. 177. You don't know——

A. I know that it is desirable to have as much surface [49] contact as possible.

XQ. 178. You don't know, then, whether or not the amount of surface contact provided in the drawing of the fitting there shown is absolutely necessary? A. That's correct.

XQ. 179. Now, I believe—I may be wrong in my recollection—that you said that if it were not for the sleeve head angle as designated on Exhibit 2, the sleeve would turn with the nut therefore score the body and the flare. Did you make that statement?

A. That's right.

XQ. 180. Will you state for the record how the sleeve head angle prevents the sleeve from turning with the nut?

A. The only contact that is shown on this particular exhibit between the nut and the sleeve is the contact between the sleeve shoulder and the nut shoulder. Now, the minute that this fitting would be disassembled, as you back off the nut from the thread, you are getting the nut coming away from the sleeve shoulder. That is almost immediate before you take a sixteenth of a turn on your wrench. If there were side contact between the sleeve and the nut, there would be engagement; and because the sleeve is free to rotate about the tube, it is possible that the nut would rotate the sleeve due to the engagement between the sleeve and the nut [50]

XQ. 181. You mean the sleeve head and the nut?

(Deposition of William D. Clark.)

A. That's right. Now, that is worse in assembly than it is in disassembly.

XQ. 182. Would it be true to say, Mr. Clark, that you have put together and taken apart 10,000 fittings of this kind? A. I would say so.

XQ. 183. You know, do you not, that there is a very definite specified clearance between the exterior of the head of the sleeve and the interior of the nut?

A. That's right, if made to specification.

XQ. 184. You know that that clearance is a good five-thousandths of an inch, don't you?

A. No, I wouldn't specify what it was. I know there is clearance, and a very designated clearance, but I wouldn't say for a fact that it is five-thousandths.

XQ. 185. That clearance is sufficient to prevent the head from binding or sticking in the nut, isn't it, even without the sleeve head angle?

A. Yes. Now, I'm not sure whether these sleeves that you are speaking about are the ones that I have been associated with—whether they are prior to the dual angle or the single angle; but I do know that they should rotate freely within the nut. The sleeve should rotate freely within the nut. There should be clearance between the sleeve and [51] the nut.

XQ. 186. You mentioned, Mr. Clark, that if the flare, I believe you said, on the tube were scored, it would be a potential failure; is that right?

A. That's correct.

(Deposition of William D. Clark.)

XQ. 187. Would a scoring of the sleeve likewise be a potential failure?

A. A scoring of the sleeve internally would, in turn, on installation score your tubing and would also give you the same potential failure.

XQ. 188. How many failures were brought to your attention resulting from scoring at that time?

A. I think there are about seven of these tube flare failures which were caused by scoring. Now, of that there were, I would say, four or five due to poor installation, due to over-torquing of the nut, thereby squeezing the flare and scoring.

XQ. 189. Are you referring now to all of your experience in the reception of reports on failures?

A. These are, as far as I can remember, the official failure reports, yes.

XQ. 190. You referred also, I believe, Mr. Clark, to the fact that similar types of AN fittings are used on oxygen lines? [52] A. That's correct.

XQ. 191. Are the fittings used on oxygen lines modified in any way different from the AN fittings which were used on hydraulic lines?

A. No. We used the same fitting.

XQ. 192. I believe, Mr. Clark, that you made the statement that the sleeve head angle, as designated on Plaintiff's Exhibit 2, the angle on the outside of the head of the sleeve, was necessary in order for that fitting to be a good fitting?

A. I believe it is.

XQ. 193. And do you know that to be true of your own personal experience?

(Deposition of William D. Clark.)

A. At one time we had fittings, at the very beginning of my experience in the laboratory, where we were getting constant galling or scoring on tube flares, and we sent those sleeves, or a sample of the sleeves, to our inspection laboratory with a drawing as shown in the AN specification for tube sleeves. They came back and said that these sleeves were not manufactured in accordance with specifications; and the discrepancy on those particular sleeves—I don't know who they were manufactured by—but the sleeve had a constant diameter from the toe of the sleeve to the shoulder of the sleeve; and the sleeves were all rejected and there was a big to-do about it out there, because we [53] were in production. We had quite a job getting an order of sleeves in there to replace them. The sleeves that we did get were to specification, and that seemed to solve our problem. However, with the new sleeves we didn't have the type of failure that we had started to experience.

XQ. 194. Do you recall when that was?

A. I think that was when I was in the laboratory the latter part of '41, I believe.

XQ. 195. Is that report still available?

A. That I couldn't say—whether it is or not.

XQ. 196. Who would know whether it is available or not?

A. Well, possibly the inspection laboratory or the purchasing department about that time.

XQ. 197. Who was head of the inspection laboratory at that time?

(Deposition of William D. Clark.)

A. There was a fellow—offhand, I can't say. I can't remember back as far as personnel. They changed rather rapidly at the time.

XQ. 198. Was that a report that came to your department at that time?

A. I know that I was one of the original ones to crab that, because we started to run into trouble in the laboratory.

XQ. 199. That trouble happened in connection with installations [54] on what airplane?

A. On the P-47.

XQ. 200. Now, the report on that, in addition to showing, as you say, an absence of a sleeve head angle, did that also show the clearance between the exterior of the sleeve and the interior of the nut?

A. I don't know whether they sectioned the nut or not.

XQ. 201. You don't know, then, whether there was insufficient clearance or not?

A. That's correct. The trouble we were having was with the sleeve, and that's what we had inspected—the sleeves—as far as I know.

XQ. 202. So far as you know, then, isn't it true that the absence of clearance may have caused the sticking just as much as the absence of the sleeve head angle?

A. It is possible that the over-all diameter might have been too great, as well as the lack of a sleeve angle, because at that time I know we were having a great deal of trouble with the sleeve sticking in

(Deposition of William D. Clark.)

the nut. And in some cases we could get the sleeve into the nut, but we couldn't get it out.

XQ. 203. Do you recall whether they were the AC-811 Series?

A. They were the AC-811 Series at that time, yes. [55]

XQ. 204. Among these UR reports, Mr. Clark, that came your way, as you said, from both the domestic and foreign fields, were they reports relative to currently produced planes or did they also include reports of planes produced some time ago?

A. Well, those from overseas would be on ships that had been produced probably four or five months——

XQ. 205. Did any of the reports include reports on ships produced, let us say, prior to 1941?

A. Yes, I would say so.

XQ. 206. Do you recall what kind of fittings those reports included? Were they AC-811?

A. They would be the AC-811, yes.

XQ. 207. Were any of the reports on planes which were produced, let us say, prior to 1938, included?

A. No. When I was in there there were very few reports on planes produced prior to 1938 that I knew of at all. I was concerned with the 47 practically entirely.

Mr. Freeman: That is the P-47?

The Witness: The P-47.

XQ. 208. Referring back once again, Mr. Clark, to the couplings of the sort illustrated in Plaintiff's

(Deposition of William D. Clark.)

Exhibit 2, which include a sleeve head angle—and I would like to refer you once again to your remark that the presence of a sleeve [56] head angle is essential, or, at least, helpful, in preventing scoring and galling of the surfaces between the nut and the head of the sleeve. In making that statement, Mr. Clark, are you drawing any comparison between the fitting of the sort illustrated on Plaintiff's Exhibit 2 and some other type or variety of the three-piece coupling?

A. We had in the laboratory, when I first went in there, some fittings of unknown design and unknown manufacture, which had been used on previous aircraft. I believe they are the old automobile-type fitting.

XQ. 209. Were they a sleeve three-piece fitting?

A. Yes, they were a three-piece fitting. I believe they were an internal flare—I believe they called them. And once those were assembled and disassembled, there was always a presence of scoring of the internal flare on the tubing; and when that fitting was installed it was noticeable that the sleeve would rotate. There was a brass fitting—an old-type fitting. I still don't know who manufactured it; but we laid the failures, or the scoring of the tube flare, to the fact that the sleeve did rotate with the nut. It fitted very tightly, and there was no room for expansion of the sleeve, and torquing the nut was very important. As soon as the sleeves were seated against the flare, you could

(Deposition of William D. Clark.)

only take another eighth of a turn on your wrench or you [57] would practically cut your flare off with your sleeve. And that's what I based my primary reason of having clearance between the nut and the sleeve upon; and, secondly, it seems apparent to me, having used them, that a thinner section at the bottom, from practical experience of using the fitting, allowing the bottom to spread or flex, is desirable rather than a straight circumference.

XQ. 210. So far as you know, that might have been a Parker fitting; is that right?

A. As far as I know, it might have been. It might be Weatherhead's. It may have been anybody's.

XQ. 211. Now, you know, do you not, from your personal experience which you have just referred to, that even in the present AN standard fitting the base of the head adjacent to the contact of the sleeve shoulder and the nut shoulder expands as well as the toe end of this sleeve? That's true, isn't it? A. I believe it is.

XQ. 212. And it is even true, is it not, that the sleeve portion of the diminished diameter also expands; does it not? A. I believe that's true.

XQ. 213. Mr. Clark, back there in about 1939 or so, at the time that you mentioned first having experience with three-piece fittings, you saw, did you not, some AC-811 Series [58] fittings which did not have the sleeve head angle on them?

A. Yes.

(Deposition of William D. Clark.)

XQ. 214. And they worked all right, didn't they?

A. Yes. That was changed, though, I believe, right after I came——

XQ. 215. If you will just answer the question, Mr. Clark. A. O.K., all right.

XQ. 216. Now, Mr. Clark, with respect to Plaintiff's Exhibit 8 in the Cleveland deposition, you made some reference to hairline contact Is there hairline contact anywhere between the parts of the sleeve illustrated on Plaintiff's Exhibit 8?

A. Well, as shown installed, there is less surface engagement than there was on Exhibit 2; but I wouldn't say that's hairline engagement. By "hairline engagement," I mean by each tool flat surface.

XQ. 217. In Plaintiff's Exhibit 2, bearing reference to the part designated, the 33 degree angle, by the legend there shown—— A. Yes.

XQ. ——is the contact between that portion and the exterior of the sleeve a line contact?

A. No, not in the sense in which I stated it, no, sir. [59]

XQ. 218. That is a surface contact, is it not?

A. It's a surface contact, yes.

Mr. Beehler: No further questions.

Mr. Freeman: No redirect.

[To the Witness]: I am going to ask you, Mr. Clark, whether you will waive the reading of your testimony and your signature to such testimony. I

(Deposition of William D. Clark.)

know it is agreeable to Mr. Beehler and it is agreeable to us.

[To Counsel]: That is agreeable, Mr. Beehler, is it not?

Mr. Beehler: It is satisfactory.

The Witness: Yes.

Mr. Freeman: Thank you, sir.

(Witness excused.)

SIGNATURE WAIVED.

(Whereupon, at 12:20 p.m., a luncheon recess was taken until 2:30 p.m.) [60]

Afternoon Session

EDWARD M. GREER

having been first duly sworn by Irwin T. Shaw, the notary public herein, testified as follows:

Direct Examination

By Mr. Freeman:

Q. 1. Will you please state your full name?

A. Edward M. Greer.

Q. 2. And where do you reside?

A. 634 Adams Avenue, in West Hempstead, Long Island.

Q. 3. And what is your business, Mr. Greer, at the present time?

A. Manufacturer of aircraft testing machinery and industrial hydraulic components.

Q. 4. How long have you been in that business?

(Deposition of Edward M. Greer.)

A. Since 1943—the early part; January of '43.

Q. 5. In what capacity are you associated with the company that manufactures hydraulic testing equipment?

A. I'm president and chief engineer.

Q. 6. Has that been your connection ever since the inception of the company in 1943? A. Yes.

Q. 7. Now, you said you manufactured testing equipment [61] and component parts thereof?

A. That's right.

Q. 8. Where is the testing equipment that you manufacture used?

A. It is used throughout the aircraft industry of the whole world—that is, those countries that are friendly to us, where our Government will allow us to sell these testing machines.

Q. 9. By "friendly to us," you had reference to friendly nations to the United States?

A. Yes, of course.

Q. 10. And the testing equipment is directed primarily to hydraulics, or for use in connection with hydraulics?

A. Well, 90 per cent of our testing machinery employs fluid dynamics, even though the testing machinery tests electrical equipment that is hydraulically driven. We are specialists in hydraulics. That's why we have the name Greer Hydraulics, Inc.

Q. 11. Do you mind giving us the names of some of the larger aircraft manufacturers that use your equipment for testing purposes?

(Deposition of Edward M. Greer.)

A. Yes. Well, we can give you Douglas Aircraft, Lockheed, Boeing—by the way, we have agreements with Boeing where we manufacture machines of their design for sale to the [62] industry. That is also true with Consolidated Vultee, both in Fort Worth and in San Diego; also Republic; Grumman; Chance-Vought; Hamilton Standard Propeller Division of United Aircraft Corporation—they are very large Navy airplane manufacturers—the Wright Aeronautical Corporation; the Pratt-Whitney Company; the General Electric Company; and their Jet Turbine Division. Have I left anybody out that makes airplane components? If I have, they should be included. I can hit the highlights. There is Allison, and their Jet Turbine Division——

Q. 12. That's a division of General Motors?

A. General Motors. Northrup, North American, the Army and the Navy, of course.

Do you want some of the foreign——

Q. 13. No.

A. How about the air lines? Do you want the air lines?

Q. 14. I was just going to ask you whether or not your equipment is used for original or initial installations or initial manufacture of planes, and is it likewise used in connection with maintenance of airplanes.

A. It is used in both. Actually, our equipment is used in three categories: one, in the research and development of aircraft and aircraft components;

(Deposition of Edward M. Greer.)
inspection and testing of aircraft and aircraft components by the manufacturer [63] of the airplane, and by the overhaul and maintenance facilities of aircraft—whether they be Government, private or air line.

Q. 15. So you sell testing equipment to both the air frame or airplane manufacturers, as well as to the air lines?

A. And as well as the component manufacturers.

Q. 16. What has been your background with respect to hydraulics generally?

A. Well, I started to work in hydraulics in 1934 and have been totally engrossed in that field ever since. That's been almost 100 per cent activity since 1934 with respect to aircraft.

Q. 17. Of what school are you a graduate?

A. The University of Detroit in Detroit, Michigan.

Q. 18. And what degree?

A. A B.S. in Aeronautical Engineering.

Q. 19. And you said that you started the Greer Hydraulics along in 1943? A. Yes.

Q. 20. Can you give me briefly some of the companies that you have been connected with from the time you left school in 1934 up until 1943?

A. After I left school I went to work for Vickers, Inc., in Detroit. [64]

Q. 21. Was that in connection with hydraulics?

A. They are the largest manufacturer of hydraulic equipment in the world, and the foremost, recognized as such by the whole industry—both

(Deposition of Edward M. Greer.)

industrial hydraulics and aircraft. I imagine that they sell 80 per cent of the aircraft hydraulic components in the United States, anyway. I was with them a couple of years; and I went down to Douglas Aircraft and worked at Douglas as a hydraulic engineer for a little more than a year.

Q. 22. Was that out at Santa Monica?

A. That's out at Santa Monica. Then I came east and went to work for Air Associates who, at the time, were located at Roosevelt Field out here at Mineola or Garden City.

Q. 23. Long Island, New York?

A. Long Island.

The activity in hydraulics, when I came out here, was almost negligible in the aircraft industry. And my reason for coming out was to develop the industry generally. I can't give you the facts and the background behind that, but it wasn't entirely by choice. Needless to say, I became a consultant for the Navy Department very soon after that. And we designed hydraulic components for aircraft from scratch—that is, starting with nothing except the background that I [65] had.

Our activity at first was confined to all Naval aircraft manufacturers, Brewster being the first one. We designed a whole hydraulic system for them. It wasn't just a matter of components, but we actually laid out the airplane and its system; and their engineers were put under my direction; and I trained their group.

Q. 24. Now, when you said you came out here,

(Deposition of Edward M. Greer.)

did you refer to your moving from the west to the east coast?

A. That's right—to the east coast.

Q. 25. Were you ever connected with Republic Aviation Corporation?

A. Well, I would like to give you that experience as we went along.

Q. 26. Go right ahead; I'm sorry.

A. Well, at Brewster I developed a hydraulic group who took over the activity there. And then, as soon as we got them going, I started with Grumman who had no hydraulic activity, and we set up a hydraulic engineering group there, and trained their men. I can give you the names of these men. They are still strong men in their companies—that were trained under my direction, such as Donald Lane, at Grumman; and a fellow by the name of Zucker at Brewster (which is not in existence any longer, so it doesn't matter). [66]

Then we started work with Chance-Vought (also Naval activity); then with Seversky who later became Republic Aviation Company. And it was at Seversky that I met Harry Marx who, soon after my meeting with him, became an officer in the Navy Department and was put in charge of hydraulics for the Navy. It was the first time the Navy Department had an activity set up as a hydraulic activity. That was about in 1942, I would say, or '41; I'm not sure of the exact dates.

Later on, after, I would say, 1942, with an associate I started a company which is now known as

(Deposition of Edward M. Greer.)

Electrol, Inc., up in Kingston, New York, to manufacture hydraulic equipment. Our initial work was with Grumman. There, again, Grumman engineers worked in our office on the airplane system. We started to do some work for Republic who, at that time, were solely devoted to Army aircraft.

I left Electrol under circumstances that are not important to this discussion. We had an awful lot of work with Republic who weren't in a position to do anything themselves; and, solely to keep them going, I joined them for a period of three months in order to set up a group of hydraulic engineers and experts, and redesigned their airplane hydraulic system. At that time I was doing a considerable amount of consulting work, which led me into the Simmond's Air Accessories Company where I was engineer manager. [67]

I started a hydraulic activity there that expanded very nicely; I was there until 1943 when I decided I would like to start making some money for Ed Greer.

Q. 27. Are you familiar with the Parker-type fittings? A. Oh, yes.

Q. 28. Now, in the testing equipment that you manufacture and sell to the air-frame manufacturers, the air lines, do you have occasion to use tubes and tube fittings in connection with testing equipment before it actually goes out into the field?

A. Yes, of course.

Q. 29. And have you personally, in the years

(Deposition of Edward M. Greer.)

of your experience in the hydraulic field, had occasion to use Parker-type fittings?

A. I have been using Parker-type fittings since 1933 or 1934.

Q. 30. That was right from the start?

A. Yes. Now, I would like to make a point.

Q. 31. Go ahead.

A. Not Parker-type, but Parker fittings. I don't know what you are referring to by "Parker-type fittings." I know of one fitting there.

Q. 32. Are you familiar with the AC-811 term?

A. Oh, yes. [68]

Q. 33. And is that one of the types of fittings that you used? A. Oh, yes.

Q. 34. And are you familiar with the AN fitting?

A. Yes.

Q. 35. Is that one of the fittings that you used?

A. That's right.

Q. 36. And as manufactured by Parker Appliance? A. Yes.

Q. 37. In the testing equipment that you manufacture are the fittings or the tube couplings used put under any pressure, or extreme pressures?

A. Oh, yes, they are generally put under pressure to their maximum designed loading as to the specifications of the manufacture. You see, in testing machinery we go beyond the aircraft pressures because we are making the gauge for testing the aircraft components.

Q. 38. And do you simulate as much as you can the actual uses to which your testing equipment is

(Deposition of Edward M. Greer.)

going to be put in the field in your own plant before they go out?

A. Right to the requirements, we simulate it completely.

Q. 39. Do you have occasion to use and re-use the tube fittings? A. Oh, surely. [69]

Q. 40. And by "tube fittings" you and I are both talking about what we call "tube flares"; is that right?

A. Yes. Well, your question needs a broad answer. We find it necessary to couple and uncouple all types of fittings to make changes under test, because our design of the test machine generally is not finished until after the machine has undergone the first test, and we find it necessary to change and revise simply because in testing machinery work you cannot, as in aircraft, in most cases, set up your system on the prototype and say, "That's it." In aircraft work, we always have to reroute lines from prototype—reroute hydraulic lines.

Q. 41. But you actually test hydraulic lines with your testing equipment before it goes out?

A. Oh, yes.

Q. 42. And in such testing you use what we call "flared tube couplings"?

A. Not exclusively.

Q. 43. But you do test flare tube couplings?

A. That's right.

Q. 44. Now, then, when you tell us that your experience has gone back for a good many years in hydraulics, that experience has been both of the

(Deposition of Edward M. Greer.)

engineering and research type as well as the actual and practical type? [70]

A. That's right. In the early days of hydraulics, which is only a few years ago, it was necessary for those of us who knew the field to actually make the initial installations as mechanics; and, oh, as little back as 1942, the engineers found it necessary to install a great many of the hydraulic components themselves, to spot them, and show the mechanics how to use the wrenches and the fittings. And that was prevalent until the time the torque wrenches became available. That was due almost entirely to the fact that you had new personnel coming in all the time—very poor mechanics, and embryo mechanics, I would say, who had become proficient only as of a recent date as a result of the war.

Q. 45. I hand you a drawing which has been marked Plaintiff's Exhibit No. 2 (Amon deposition), and will ask you to look at the drawing and the nomenclature thereon, and ask you if you recognize that as a Parker-type fitting or the Parker fitting that you purchased from Parker and used.

A. I recognize it as the Parker plant fitting.

Q. 46. Now, you have actually used the fittings of the kind exemplified in Plaintiff's Exhibit No. 2?

A. Yes.

Q. 47. You note that there is a statement or term upon Plaintiff's Exhibit No. 2—"sleeve head angle"? A. Yes. [71]

Q. 48. Are you familiar with that angle?

A. Yes.

(Deposition of Edward M. Greer.)

Q. 49. Or the relationship of the sleeve with respect to the nut? A. Yes, I am.

Q. 50. Do you know what it does or its purpose or its function? A. Yes.

Q. 51. Will you tell us?

A. It's the clearance allowed for the possibility of spreading of the sleeve as a result of torquing down on the nut, allowing a condition where binding wouldn't occur.

Q. 52. In other words, the toe of the sleeve head may bow outwardly or spring outwardly?

A. It will bow outwardly.

Q. 53. That is true when the nut is brought up to proper torque?

A. That's right. I would say it goes beyond that. The mechanic in the field, especially on maintenance work, doesn't know what proper torque is, and will overload them; and, in many cases, actually distort the sleeve, and it gives him a little opportunity or some opportunity of re-using the thing without scoring up the fitting.

Q. 54. Is there anything wrong with scoring up the fitting [72] (using your own terminology)?

A. Oh, sure.

Q. 54. What happens when a fitting is scored up?

A. Well, it's a point where a fracture can start and will start. It's a point where leakage will definitely start if the scoring is on the wrong side; and certainly it will start a point of corrosion.

Q. 55. When you say scoring is a point where a fracture may start, is it correct for me to say that

(Deposition of Edward M. Greer.)

that is a possible hazard? A. Oh, definitely.

Q. 56. And undesirable?

A. Oh, sure. The fact of the matter is that generally in the better aircraft plants good practice demands that a scored tube (regardless of whether it is badly scored or just scratched) be not permitted to be used on the aircraft.

Q. 57. Because of the great hazard involved?

A. Yes, it's considered a great hazard.

Q. 58. Now, before we go further with——

A. In our plant we have careful inspection against scoring or scored faces, and so forth.

Q. 59. And the likelihood of scoring, when the fitting is put on or being installed, is that such scoring likewise will bring about a potential hazard? [73]

A. Will you restate that again? I want to follow you.

(Reporter reads last question as recorded.)

A. Yes; the same question was asked before. That is why I wanted it re-read.

Q. 60. It doesn't make much difference when the scoring takes place; it's bad; is that correct?

A. It's bad at any time. I would like to point out here that where the fittings are used with fuels, care has to be taken to see that the finish is protected. That's why we have this anodyzing; so that we do not have a potential place for corrosion; and some of our high octane fluids will start a very, very quick corrosion condition which can cause failure in fire.

(Deposition of Edward M. Greer.)

Q. 61. That is, if you have a scored part that is likely to bring about leakage?

A. Yes. But I make the greater point in the fact that you can have corrosion, rusting, as we call it in ferrous metal terminology, eating away the metal, with the possibility of a fracture occurring as a result of pressures developing the line in excess of their design, which happens very often, which would not only cause a leak, but a real blow-off of the line with a real fire hazard.

It has happened in the aircraft industry from time [74] to time as a result of corrosion. It is for that reason, for instance, that the specifications of the AN Board are so rigid on finish.

Q. 62. Will you tell us here briefly what is meant by hydraulics in connection with the aircraft industry?

A. Well, it's a transmission mechanism, to transmit work from one place to another.

Q. 63. And in that transmission of work from one place to another, tubes interconnect the power at one place to the work to be done at another place?

A. That's right. Actually, a good definition of hydraulics would be a mechanism for the transmittal of energy by fluids through pipes. That is a recognized definition.

Q. 64. And when you transmit energy to pipes—— A. Fluid through pipes.

Q. 65. ——that, then, necessitates the tube or pipe being connected to the power means at one end and the operating means at the other end?

(Deposition of Edward M. Greer.)

A. That's right.

Q. 66. And when you use the flared ends on the tubes, is it true that the Parker-type fittings are used to make the inter-connection between the tube and the motivating means at one end, and the operating means at the other end?

A. In the airplane industry, it is almost [75] exclusive.

Q. 67. And the power transmitted from the power mechanism over to the work to be done comes under the general heading of hydraulics?

A. That's right.

Q. 68. Now, in the aircraft industry can you give us a few of the places where hydraulics are employed for operating mechanisms of the aircraft?

A. Well, such as landing gear, wing flaps—is that what you mean?

Q. 69. Yes.

A. Cowl flaps, landing gear doors, bomb doors, gun controls, gun turrets, winshield wipers, shimmy dampers, steering mechanisms. Do you want to go on there? There are a great many of them.

Q. 70. These items that you have given us—you know that from your own personal experience?

A. Yes.

Q. 71. And you have actually seen them in operation?

A. I have actually designed them in aircraft and have tested them in operation.

Q. 72. And actually installed units on aircraft?

A. Yes.

(Deposition of Edward M. Greer.)

Q. 73. Or supervised the installation?

A. Supervised and installed, both. [76]

Q. 74. So that, in addition to the testing equipment before the units are put on a plane, you likewise have used fittings in connection with actual installations?

A. On airplanes, oh, yes. My use of tube couplings of this kind has been much heavier in the airplane industry than in the test machinery field.

Q. 75. You mentioned a moment ago, coming back to the fitting, that it is desirable not to have the sleeve bite into or engage the nut? A. Yes.

Q. 76. What is the hazard if in fact the sleeve does gouge or project into the nut?

A. Oh, there are very many detrimental effects of a condition like that. First of all, the mechanic putting the nut down may stop before he has seated the tube, because in many cases he works totally by feel, and he has an exaggerated feel condition by the torque increment that is a result of the sleeve and the nut rubbing against each other. That would result in leakage in the system if a careful test wasn't made afterwards.

The second condition, of course, is that in scoring, you have developed a weak point. These tube fittings are made of very light ductile material, and because of it being an aircraft component, weight and material is held at a minimum. [77] The design is such that the factors of safety are rather narrow; and there is no room for a potential point of breakage.

(Deposition of Edward M. Greer.)

In the design of the fitting itself nothing has been allowed, from a safety standpoint, to start a fracture. We all recognize that in any piece of material, if you have a sharp break anywhere, whether it be small or large, a load on that material will cause the break at the point where you have a sharp cut or abrasion. That's where the break will start.

Q. 77. Now, if the nut and sleeve are jammed or engaged, what happens when you remove the nut or attempt to disassemble the assembly?

A. If you are jammed?

Q. 78. Yes.

A. You can pull the tube right off in some cases and twist the tube, because you won't only jam up against the nut, but you may jam right up against the tube too. I have seen occasions where, by trying to remove the sleeve under those conditions, you actually twist the tube, especially if the tube is made of aluminum alloys—as they are in aircraft—on the quarter-inch sizes, for instance. That's a condition that you run into very, very often.

Q. 79. In other words, actual twisting of the tube puts [78] an undue tension or strain on the tube?

A. It puts a torsional load on the tube and will cause it to twist.

Q. 80. And is that likewise a potential hazard?

A. You have to throw the tube away.

Q. 81. And if you don't throw the tube away,

(Deposition of Edward M. Greer.)

but you put the torsional tension on the tube, is that undesirable from a safety factor?

A. Well, the chances are you will never get it to hold fluids under pressure without leaking. And if you do get it to hold pressure, the chances are you will have to pick the pieces of the airplane up some place.

Q. 82. In other words, it's hazardous?

A. It's more than hazardous; it's suicide; it's a critical point.

Q. 83. What happens if the tube doesn't twist, but the sleeve and the nut rotate on the tube?

A. You will score the top end of the tube.

Q. 84. And by the "top end"——

A. That is the top of the flare, as I pointed out here. You will either score the tube or you will score the sleeve, and you will never be able to make a tight seal as a result of it. You've got an area sealed here (indicating), and you have to have a smooth point here all the way through. You [79] are depending upon a metal-to-metal fit.

Q. 85. When you used the term "top of the sleeve," you were——

A. No. I say the top of the tube, the top of the flare, or the bottom of the sleeve. If you have a score in here (indicating)——

Q. 86. Indicating the contact between the inside of the sleeve and the outside of the flare.

A. ——you have leakage, because you are dependent on a smooth metal-to-metal fit at all times. If it weren't for that condition, you wouldn't need

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a sleeve at all. The only reason you've got a sleeve is to prevent that scoring; otherwise, you could come right down on the thing.

Q. 87. In other words, the scoring or improper interconnection between the sleeve and the flare would, in fact, bring about leakage between the tube and the body of the coupling?

A. You destroy the fitting beyond its use.

Q. 88. You would just have a bad fitting?

A. Yes. It's not acceptable for use. You couldn't hold pressure.

Q. 89. In other words, it would not function properly?

A. That's right. And if you do get it to function by over-loading it, well, it's only good until somebody takes it apart again, and then it has got to be thrown away [80] definitely. But it's a dangerous thing.

Q. 90. If it is deformed or injured because of improper interconnection——

A. The only way you can get a seal on that is to change the physical dimensions of the fitting by brute force, to get it to seal.

Q. 91. And that is not desirable?

A. I should say not.

Q. 92. Now, you explained the angle on the outer wall of the sleeve and that the parts expanded as the nut was brought home or tightened; is that correct? A. Yes.

Q. 93. Now, does the application of the expansion of those ends of the tube tend to prevent the

(Deposition of Edward M. Greer.)

parts from becoming unloosened due to vibration?

A. Yes. You have a hoop stress condition developed on there, an actual gripping all the way around the tube as a result of the dynamic forces in the material. You have a condition where this flared tube and the nut can be likened to a spring, with an inward component of load, which acts not only as a seal, but as a mechanism for keeping the parts together.

Q. 94. Somewhat like a lock washer?

A. As a lock nut. [81]

Q. 95. A lock nut? A. A lock washer.

Q. 96. And is that brought about by hoop stress or hoop tension? I think that's the term.

A. We call it hoop stress.

Q. 97. And you have heard that term used——

A. Well, the actual technical term of that is known as Barlow's Law which states that the stress on a material is equal to the pressure times the diameter divided by two times the wall thickness. And that means that the greater the diameter, the greater stress the material will take. And as you can see as this flare comes out, you have a higher stress point at the nose than you have in the back. So the stress is a function of diameter over thickness, neglecting all this other stuff in here which isn't important (indicating).

You can say that the scientific or physical term, as known to students of physics even in the high schools, is that stress is a function of diameter over wall thickness. That's hoop stress.

(Deposition of Edward M. Greer.)

Q. 98. So that the application of hoop stress is desirable in the fitting of the type that we have here exemplified by Plaintiff's Exhibits 2 and 8?

A. Well, it's the only way of doing it without adding [82] other features. There are fittings, to my knowledge, that are satisfactory that do not use the hoop stress feature here, but they have other mechanisms of one kind or another to do the same thing. Generally, that means more complications.

Q. 99. Now, is there any advantage or desirable feature or function in having substantial engagement between the sleeve shoulder and the nut shoulder? A. Oh, yes.

Q. 100. What is that? Will you please explain?

A. The strength of the fitting is dependent entirely on that shoulder. The load, being a function of the area under contact, the greater the area the less load required by the nut to hold. In other words, if this area were shortened substantially (indicating), you would have a low factor holding it down, but you would have a very, very small engagement which would tend to pull out.

Q. 101. It is true that in a fitting of the Parker type, as here exemplified, the toe or the nose of the sleeve grows outwardly a greater distance than the bowing out at the hole or sleeve shoulder?

A. I guess it would. I've never measured it, but I'm sure it would. They would have to, because you're working on a lever principle there. [83]

Q. 102. Now, calling your attention to Plaintiff's Exhibit No. 8 and the differential angle or the two

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angles on the sleeve, with respect to the outer wall of the flare, is it true that as the nut is tightened or brought home, or the maximum torque placed thereon, the space in between the sleeve and the outer wall of the flare will become less and less as the torque increases?

A. Yes. This, by the way, is recognized as a superior fitting from a design standpoint than this one (indicating).

Q. 103. In other words, the one that you referred to as the superior type——

A. We have initial toe contact with the sleeve because there you actually have a designed dynamic load with sufficient give to make full contact of the fitting in a rolling motion rather than trying to squeeze the whole face of the flare on the tube.

(Discussion off the record.)

A. (Continuing): It prevents the possibility in soft tubing of actually cutting off the flare as a result of extra highwrench loading in repeated assembly and disassembly which in many cases causes the flare on the tube to diminish in size in relationship to the amount of times that it is wrenched up and down. When I say "wrenched," I mean using the wrench.

Mr. Freeman: That's all, you may cross-examine, Mr. [84] Beehler.

Mr. Beehler: Thank you.

(Deposition of Edward M. Greer.)

Cross-Examination

By Mr. Beehler:

XQ. 104. Mr. Greer, you said, I believe, that you designed a hydraulic system for the Brewster Aircraft plane? A. Yes.

XQ. 105. Can you give us the date of that?

A. I think it was '39. Yes, it was '39 and '40.

XQ. 106. Now, among these hydraulic groups that you set up for the various aircraft companies, there was one you set up for Republic?

A. Yes.

XQ. 107. Was Mr. Clark, who testified here today, among that group?

A. No, he wasn't in the hydraulic group at the time, but he was employed by Republic. I don't remember what his function was at the time, although he worked with our hydraulic people as a coordinator with installations, I believe it was.

XQ. 108. Were you one of the owners and originators of Electrol or were you called in as an engineer?

A. I was one of the originators but not one of the owners I found out later. That's why I left.

(Discussion off the record.) [85]

XQ. 109. I believe you said, Mr. Greer, that you were familiar with Parker fittings. A. Yes.

XQ. 110. And you distinguished that from the Parker-type fittings? A. Yes.

XQ. 111. As early as 1933 or 1934?

A. That's right. We used them at Vickers in

(Deposition of Edward M. Greer.)

Detroit on commercial and naval hydraulic installations.

XQ. 112. The Parker fittings which you knew at that time were three-piece fittings? A. Yes.

XQ. 113. That is, the fitting with the sleeve in it? A. That's right.

XQ. 114. With respect to the sleeve portion of the fittings, which you used in 1933 or 1934, will you refer on Plaintiff's Exhibit 2 to the portion of the sleeve head labeled "sleeve head angle," and tell us did the fittings——

A. Which one of these are you referring to—Exhibit 2?

XQ. 115. No. 2.

A. The sleeve head angle, yes. You are referring to that?

XQ. 116. Yes. Now, the Parker fitting which you used in [86] 1933 or 1934 had a sleeve head angle on it?

A. I don't remember it having it.

XQ. 117. You don't remember whether it did or not, or do you say that it did not?

A. I don't remember it having it. I am inclined to think that it did not, but I can't make a definite statement on that. It was a long time ago.

XQ. 118. You can't be sure whether it did or did not?

A. I can't be sure whether it did or did not, but I would venture to say that it did not.

XQ. 119. Do you remember, with respect to the same sleeve head and sleeve in 1933 or 1934, whether

(Deposition of Edward M. Greer.)

there was a clearance between the exterior of the sleeve head and the interior of the nut?

A. Yes, there was some.

XQ. 120. And do you recall whether or not at that time there was difficulty with the sleeves sticking in the nut? A. Yes, there was.

XQ. 121. Do you recall any specific instance?

A. No. I know we had a considerable amount of difficulty with fittings generally.

XQ. 122. Do you recall what was done to alleviate that difficulty? A. No. [87]

XQ. 123. Do you recall if anything was done to alleviate that difficulty?

A. Not until after the aircraft activity started, when the aircraft manufacturers, as a requirement of light weight and high stresses, demanded that something be done to clarify the whole fitting business as a whole, when radio design changes were attempted and standardizations were developed.

XQ. 124. You said, I believe, that along about that period, 1933 and 1934, in your use of Parker fittings the sleeve head expanded into the nut when the sleeve was made up; that's correct, isn't it?

A. Will you state that again? I don't follow that. In 1933?

XQ. 125. 1933 or 1934—that period that you mentioned, when you first began using Parker fittings—— A. Yes.

XQ. ——you stated, I believe, that when the fitting is made up, pulled together, the head of the

(Deposition of Edward M. Greer.)

sleeve expands outwardly into the interior of the nut?

A. No. I said that as a general statement of the fitting, not as a statement as to the time.

XQ. 126. Then let me ask you this: Did the fittings which you used in '33 or '34 expand that way with respect to the [88] sleeve head?

A. I don't know. Our difficulties were encountered with the shearing off actually of the top of the sleeves. There was our weak point—not the sleeves, but the shearing off of the nut. It was just torquing down until it was cut off. And that was a matter of lack of technique or knowledge more than anything else.

XQ. 127. You are speaking now of the part labeled "nut shoulder" on Plaintiff's Exhibit 2?

A. Yes, that's right. And that may have been due to the binding action of the sleeve and the nut, or to the fact that improper wrench loads were used.

XQ. 128. It is true, is it not, Mr. Greer, that the Parker fittings which you used in about 1934 had a nut shoulder which was tilted at a slight angle rather than being straight across; isn't that true?

A. Yes, I believe that's true, now that you mention it.

XQ. 129. And it was the tilt of that angle, I assume, that caused the shearing off or damaging of the nut shoulder?

A. Oh, I wouldn't say that, no. I don't think that the tilt of the nut, the angle of the nut, would make any contribution to shearing at all.

(Deposition of Edward M. Greer.)

XQ. 130. Well, what would you say that it would do if the [89] shoulder on the nut were tilted at an angle, as you say it probably was?

A. I don't think it actually makes a heck of a lot of difference, except to give a longer face of contact. But I would say, speaking purely as an engineer, that the value of that was negligible. I wouldn't give it any value at all.

XQ. 131. Now, with respect to safety factors on a Parker fitting made according to the drawing of Plaintiff's Exhibit 2, for example, there is illustrated contact between a sleeve shoulder and a nut shoulder, as there labeled. Do you have any idea what the safety factor is there in the selected area of surface contact?

A. No. But I could calculate it.

XQ. 132. Could you estimate it or would you need a long calculation to arrive at an answer?

A. I would need some time on it. I would have to know the diameter and the pressures and the materials and the strength of those materials.

XQ. 133. Well, just from pressures which you have used in tests, could you estimate or give us some approximate estimate of the safety factor?

A. I don't think that from an operational standpoint that matters at all. I think your problem of strength there isn't one from operating pressure, but one from mechanically [90] sealing the parts together as a result of improper tools and loads. I think that's the most important factor in a fitting of this kind. I don't think that you would have to

(Deposition of Edward M. Greer.)

worry very much if that sleeve had a smaller area, say, half the area, from an operational standpoint.

XQ. 134. The area at the shoulder contact, you mean?

A. At the shoulder. That shoulder contact, I believe, is important only to the mechanical assembly of the parts.

XQ. 135. It's a mechanical thing, then, directed to correct the errors that a mechanic might make if he over-torques?

A. That's right; it's a matter of giving a sufficient amount of work area so that he wouldn't do damage under normal operating loads. And if you ask me to define "normal operating loads," I will tell you I don't know.

XQ. 136. All right, I won't ask you.

A. I would like to bring up this point, though, I think we all understand: that up until about four years ago all mechanics depended on feel more than anything else to tighten up fittings. It was purely a business of knowing in your fingers when to stop. I still do it today. I have occasion to put tubing together, and I did some last Saturday. And I wouldn't trust one of my mechanics to put them together the way I do. Perhaps if I had a boss, he would fire me; but it's a matter of knowing when to stop when you reach a certain [91] load. That's all experience.

XQ. 137. Now, you said, I believe, in your direct examination, that it produces a bad condition if the sleeve gouges into the nut. That's correct?

(Deposition of Edward M. Greer.)

A. The sleeve gouging into the nut, oh, yes.

XQ. 138. Suppose the sleeve gouges into the flare; is that a bad condition, too?

A. It's worse.

XQ. 139. Will you refer, please, to Plaintiff's Exhibit 8? A. Yes.

XQ. 140. And I direct your attention particularly to the portion of the sleeve labeled "33 degree angle," and the junction of that with the 18½ degree angle. A. Yes.

XQ. 141. Is it not true when that coupling is coupled up that the sleeve gouges into the flare?

A. No, it doesn't.

XQ. 142. What happens when that particular sleeve is drawn up tight to make a fitting?

A. It slides over. The angles of motion are such that due to the stress developed, the sleeve opens up actually and sits down on the tube flare. I think, if you will examine the flares after the couplings have been put together, you will find that you do not have gouge marks. It has been [92] my experience, under inspection of repeated assembly and disassembly, that we do not gouge the tube or we do not score the face of the sleeve.

XQ. 143. Your last remarks, Mr. Greer, would then apply equally well to aluminum or the copper silicon sleeves?

A. You mean aluminum tubing and copper silicon sleeves?

XQ. 144. Yes.

A. I don't think so. I think with aluminum

(Deposition of Edward M. Greer.)
tubing and copper silicon sleeves you may have a condition where you would either score the tube or flatten it out. My experience there is such that I can't speak with authority.

XQ. 145. Would the gouging or scoring in that event improve the seal?

A. No. Scoring or gouging never will improve the seal. The fact of the matter is you won't have a seal.

XQ. 146. Now, you also referred, I believe, Mr. Greer, to the presence of hoop stress as a beneficial factor in the holding of a coupling together to prevent a leak in the coupling of this kind. With respect to the Parker fittings, which you used in or about 1934, was the factor of hook stress important there, too, in holding the fitting together?

A. It was; but unfortunately it didn't exist to the extent that it does today; and under vibrating conditions [93] the nut would loosen up, and we would have a leak. It was prevalent in those days for mechanics in both the industrial and aircraft fields to inspect periodically and continuously tighten the nuts, the result being that before long they had nothing left to tighten, and it had to be replaced.

XQ. 147. Can you state for the record why the hoop stress in those fittings was not as effective as the hoop stress in the fittings used today?

A. I think it was more a matter of angle loading than anything else.

XQ. 148. Which angle have you reference to?

(Deposition of Edward M. Greer.)

A. The loading between the sleeve and the tube itself.

XQ. 149. And is it the interior of the sleeve and the exterior of the tube; is that correct?

A. Yes, it's either that or the fact that we didn't allow enough clearance for the sleeve to come out. I am speaking now, just thinking this thing out. But I would say, to answer your question directly and not from experience, concerning the conditions that existed in the early days of my use of this fitting, we did have a definite condition where the tube nut would loosen off due to vibration. And to answer your last question, as to why that condition existed then and doesn't exist today, I would only have to [94] conjecture. By that I would say that it was due to two things: No. 1, the fact that we did not have a clearance between the sleeve and the nut, and therefore was not able to induce hoop stress into the sleeve——

XQ. 150. Was that equally true of all sizes, as you recall it—the loosening up?

A. My experience in these fittings up to very recently was limited to sizes from the quarter-inch size up to the three-quarters-inch size, and very heavily on the three-eighths and half-inch sizes. We consider that those sizes are small and pretty much equal up to the three-quarters size.

XQ. 151. Does your comment, then, apply to all of the sizes which you knew at that time?

A. Well, no. In trying to recall this thing, I

(Deposition of Edward M. Greer.)
would say that we had more trouble with the smaller sizes.

XQ. 152. Which sizes?

A. The quarter-inch, three-eighths, and half-inch.

XQ. 153. More so than in sizes over half-inch?

A. Yes. That might be due to the fact that manufacturing tolerances in the larger sizes were not enough to give you sufficient clearance to get a stress in there. I don't know. There is also the factor that up until a few years ago we did not know how to flare tubing. I believe [95] all of us understand that. It wasn't until recently that we could make real flares.

XQ. 154. Now, referring again, Mr. Greer, to Plaintiff's Exhibit 8, you said, I believe, that when that nut is drawn up and the fitting closed to complete the seal, the toe of the sleeve head hit first?

A. Yes—contacts first.

XQ. 155. What portion of the sleeve head do you consider the toe?

A. The point of contact between the flare and the sleeve.

XQ. 156. Is that a line contact or a surface contact in Plaintiff's Exhibit 8?

A. Well, that's comparative. As the drawing is shown here in large scale it is shown as an area contact, but I believe in actual scale that would be a line contact. I would say a line contact in this case here would be limited to a thickness of about a thirty-second of an inch. Anything beyond that I would call an area contact.

(Deposition of Edward M. Greer.)

XQ. 157. Does this drawing, as it appears before you, look as though it were not drawn to scale?

A. I would say it is drawn to scale, but it's a very large fitting.

If we could look at an actual drawing of a [96] fitting, then we could make a very definite statement. But we know it is a line seal rather than an area seal in the industry, referring to Parker, of course.

XQ. 158. I see. And a line seal is a better seal than an area seal; is that correct?

A. Always. That's why all valves are made with line seals. By that I mean a differential angle of contact on poppets and seats.

XQ. 159. Mr. Greer, will you lay your pencil on Exhibit 8 at the area where the liquid passes through the fitting?

A. Right through here (indicating).

XQ. 160. Now, will you draw with your pencil the path of a leak out of that fitting?

A. The path of a leak?

XQ. 161. Yes.

A. There are many paths. The first path would be this way (indicating).

XQ. 162. And your pencil traces along between the surfaces of the toe of the body and the inside of the flare on the tubing; is that correct?

A. That's right.

XQ. 163. Will you continue tracing the probable outlet of the leak past the area just mentioned?

(Deposition of Edward M. Greer.)

A. Yes. Either through here (indicating), which is [97] the most logical, or through here (indicating), which is secondary, and very seldom through here (indicating).

XQ. 164. Now, the portion which you indicated as secondary was the portion between the exterior of the head of the sleeve and the interior of the nut; was it not? A. Yes.

XQ. 165. And I believe you said earlier in your testimony that it was desirable not to have the head of the sleeve pressed outwardly into the interior of the nut; is that correct?

A. I don't follow you there. Let's work with a pencil here. Will you illustrate what you mean?

XQ. 166. You stated before, I believe, that one of the virtues of the triple fitting is the fact that the head of the sleeve maintains some springiness and does not fill the interior of the nut?

A. That's right.

XQ. 167. Is that correct?

A. Not as a function of the fitting, but as a function of the assembly of the fitting.

XQ. 168. Well, then, is it not true that there is more likely to be space for the leak to pass outwardly between the head and the nut than it is between the head and the flare? [98]

A. Well, it would make no difference if you allowed two-tenths of a thousandth clearance in here or a tenth of a thousandth or a sixteenth of an inch here (indicating). You would get the same amount

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of leakage through the fitting. You aren't dependent upon that as a source of the leakage. That's a clearance factor, regardless of whether you design it or not.

XQ. 169. Then, so far as those surfaces are concerned, it makes no difference whether a leak would go through there or not; is that correct?

A. It's not designed for it to be leak-proof, or it is not considered as a leak-proof portion of the fitting.

XQ. 170. Well, then, with respect to a leak between the exterior surface of the flare and the interior surface of the head of the sleeve, if that were leak-proof or insured against leakage, then fluid leaking from the coupling would readily pass around the exterior of the sleeve, would it not?

A. It would. But I don't see where that makes any difference.

XQ. 171. If you had, then——

A. If you had a leak through the flare, between the flare and the body——

XQ. 172. Fine. [99]

A. ——you've got a very bad fitting, in the first place——

XQ. 173. Yes.

A. ——and it should be changed. But suppose you had that leak. The path of leakage, as you are describing it, would carry you between the shoulder of the sleeve and the nut. If that's full of oil under pressure, it would make no difference, providing you

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had an adequate seal between the shoulder of the nut and the shoulder of the sleeve on the top.

XQ. 174. Is the shoulder contact between the sleeve shoulder and the nut shoulder designed for a tight fit—that is, a leak-proof fit?

A. No, I don't know; I don't regard it as such, because you have two rubbing surfaces, and in torquing conditions you are bound to break up any smoothness of surface to prevent leakage. I don't think that that is considered a leak-proof joint from a design standpoint.

XQ. 175. It is true, then, is it not, that the most important surfaces to have leak proof are the surfaces between the body and the interior of the flare on the tube? A. Yes, yes; that's true.

XQ. 176. And it makes no difference at all, so far as leak-proof contact is concerned, whether or not the interior [100] of the head of the sleeve and the exterior of the flare on the tubing are in sealing relationship to each other?

A. Oh, I wouldn't put it entirely that way. It is a secondary seal. I would put it in a second or third class.

XQ. 177. Even if that were a tight seal, it could still leak out past the threads; could it not?

A. It could, but not easily. But you are dependent entirely on the surface between the flare of the coupling and the flare of the tube to do your sealing.

XQ. 178. And when you say "coupling," you refer to the body portion; is that correct?

A. The body, yes. I think that is the correct

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terminology—to call the body the coupling—isn't it?

XQ. 179. We can say, for consistency, that Plaintiff's Exhibit 8 labeled the body portion—this portion on which I lay my pencil—is the portion you refer to? A. Yes.

Mr. Freeman: And that portion was labeled "body"?

The Witness: Yes.

Mr. Beehler: No further cross——

Mr. Freeman: That is all.

Now, is it agreeable to you, Mr. Greer, that you waive the reading of this and waive your signature to it, if it is likewise agreeable to Mr. Beehler? [101]

The Witness: Yes, surely.

Mr. Freeman: Thank you.

(Witness excused.)

Mr. Freeman: Let the record show that we will resume here at 9:30 tomorrow morning.

(Whereupon, at 4:15 p.m., an adjournment was taken until Wednesday, May 11, 1949, at 9:30 a.m., at the same place.)

SIGNATURE WAIVED. [102]

ROLAND C. BERGH

having been first duly sworn by James W. Maxwell, the notary public herein, testified as follows:

Direct Examination

By Mr. Freeman:

Q. 1. Will you please give your full name?

A. Roland C. Bergh.

Q. 2. And your residence?

A. 191 Briarwood Crossing, Cedarhurst, New York.

Q. 3. What is your business or by whom are you employed?

A. Republic Aviation Corporation, Farmingdale, New York.

Q. 4. In what capacity are you employed by that company?

A. I am chief staff engineer and am responsible for the supervision of all the mechanical devices that are used in our airplanes, including the engineering aspects and the procurement of all accessories, equipment, and things of that type.

Q. 5. How long have you been with the Republic Aviation Corporation at Farmingdale, Long Island, New York? A. Since, I think, April, 1935.

Q. 6. And you entered that company's employ as an engineer? A. That is correct. [104]

Q. 7. What is your educational background, with reference to collegiate training?

A. I graduated from Princeton University in 1927, Department of Physics, and then took a postgraduate course at New York University, Guggen-

(Deposition of Roland C. Bergh.)

heim School of Aeronautics, receiving the degree of Aeronautical Engineer in 1929.

Q. 8. Have you been primarily engaged in engineering work with respect to the engineering field since you graduated in 1929?

A. Yes, sir, exclusively.

Q. 9. Can you give me quickly your connections from the time you left school in 1929 until 1935, when you entered the employ of Republic Aviation Corporation?

A. Yes, I had only one job prior to my employment at Republic Aviation Corporation, and that was at Fleetwings, Incorporated, formerly of Garden City, Long Island, and then they moved to Bristol, Pennsylvania. My position there was, first, just engineer, and finally chief engineer and vice-president, until I left in late 1934.

Q. 10. You said that you were chief staff engineer of Republic Aviation and in charge of procurement or, at least, supervision of all mechanical devices.

A. The engineering aspects of all equipment used in the airplanes. [105]

Q. 11. And does that include fittings for coupling tubes to hydraulic devices used in planes?

A. Yes, it includes all equipment, small hardware and standard parts.

Q. 12. Are you familiar with the Parker 811 fitting or the fitting sometimes called the AN fitting used in planes?

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A. Yes, I am very familiar with it, because I have been a member of the Industrial Committee that has dealt at very great length with the aspects of the fluid line fittings and our committee was very helpful in the initial setting up of the so-called AN standard drawings that the Air Force uses for replacing the so-called 811 fitting, which was the Parker fitting.

Q. 13. Is that committee you mentioned called the SAE Committee?

A. Yes, SAE-A3, and that committee's work is, I think, in connection with fluid line fittings and hydraulic hose assembly, as I recall it, and its job was, to a large extent—in fact, I think that for a period of four years during the war it dealt almost exclusively with working the bugs out of the AN standard fluid line fittings.

Q. 14. Can you tell me briefly the function of a tube fitting?

A. The function of the tube fitting is to [106] make a liquid-tight connection between two lines or between—by "line" I mean either a rigid tube or a hose—to make a liquid-tight connection between a line and another line or between a line and a piece of equipment or accessory, and to provide a connection whereby fluid can flow from one place to another, either under low or high pressure, without leaking.

Q. 15. The flare tube fittings include, in addition to the fitting itself, a flare upon the tube; is that correct? A. That's correct.

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Q. 16. And are they sometimes called flare tube fittings?

A. Yes, I think that terminology has been used for a good many years and is popularly accepted throughout the industry, and it also serves the purpose of identifying this type of connection, as compared to one where the tube does not require expansion or flaring to make a connection. There are other fittings on the market now which do not require any prefabrication before the joint is made up.

Q. 17. You said first that a tube fitting was to prevent leakage and provide a liquid-tight joint; is that correct?

A. Yes, to provide a liquid-tight path for the flow of liquid. Of course, the fluid can be either air, gas, oil, gasoline, or anything like that.

Q. 18. Or a vacuum? [107] A. Yes.

Q. 19. And the joint brought about by a coupling or fitting is accomplished by——

A. By making up the sleeve and the nut—let me put it this way: over the tube is slid a nut and sleeve and the tube is then flared, which will prevent the removal of the sleeve and nut, and then the assembly is brought up to a male union or fitting and the nut is tightened against the male union.

Q. 20. Is that male union sometimes referred to as the body? A. Yes, the body of the fitting.

Q. 21. And I take it that the fitting is to provide a mechanical grip for holding the tube mechanically interconnected to the——

A. To the body. I will put it this way: there are

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basically two kinds of forces or strains that the assembly is required to take; one is the radial force created by the fluid pressure, and the other is the longitudinal force created by the effective inside diameter of the tube, tending to push it away from the body. This produces another force axially along the tube, tending to create a separation. The fitting serves that dual purpose, and it also of course has other purposes, such as the weight of the assembly, the [108] weight of the line, and so forth, and it has to take vibration, flexing, and a certain amount of mechanical force or weight incidental to assembling the airplane, where mechanics pull on the plumbing a little bit to get it through things and there is a slight flexing of the parts of the assembly.

Q. 22. By the term "plumbing" you have reference to the various tubes and pipes on a plane?

A. Yes, by that I mean all the rigid and flexible lines where they connect either to themselves or to rigid equipment attached to the airplane structure.

Q. 23. Will you give me, just briefly, some of the devices that are operated through the medium of either fluid or air, where the motivating force is at one point and the thing to be operated is in an exposed position where the interconnection is brought about by tubes and couplings of the kind we are here talking about?

A. I would say that there are really two basic functions of a plumbing installation: one, and the most important, obviously, is to transmit power

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from one place to another—and by "power" I mean either a gas or a liquid under pressure and, consequently, to act as a means of conveying a fluid which is used in the engine or the lubricating oil system of the engine.

Q. 24. I hand you a drawing which has been marked [109] Plaintiff's Exhibit No. 2 (Amon deposition) and will ask you to look at the illustration there and state whether you recognize that as an AN fitting.

A. Well, it very closely approximates a picture of a made-up joint or a section through it.

Q. 25. And do you find there the parts legend "Body nut and sleeve"? A. Yes.

Q. 26. What is the relationship of the outside wall of the sleeve within the nut relative to the inner wall of the nut?

A. Well, there are three surfaces, starting from the outer end, as an axial or cylindrical clearance, which has to be of a reasonable amount to allow for machining variations, I should say, between concentrics and between the manufactured nut and the manufactured tube, and that clearance has to be there so that the nut can be centered entirely—I mean the tube can be centered, together with the sleeve, entirely upon the angle of connection with the body.

Perhaps I haven't made myself quite clear. What I mean is that in order to get a good fluid-tight joint, which is obviously important, between the inside of the tube and the male end of the body,

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that is the fluid connection that has to be sealed, and that flat surface has to be perfectly concentric in order to get a fluid-tight joint, and that is [110] the reason for the procedure I have just described. Then beyond that is a washer that has a flat surface between the shoulder of the nut and the corresponding shoulder of the sleeve, and the forces in tightening the nut against the body are applied at this surface to the sleeve, which forces the sleeve tightly against the outside flare of the tube.

The width of that shoulder is very important because, if it is too narrow, it can deform either the sleeve shoulder or the nut shoulder. Of course, you want a clearance at the inside diameter of this washer, but you don't want an excessive clearance or you do not have enough biting surface on the shoulder, and, thirdly, you have a more or less cylindrical section between the inside of the nut and the outside of the sleeve. That clearance has to be adequate, to take care of the inherent expansion of the sleeve due to torque tension while the fitting is being made up, or forces due to the inclined plane action tend to expand the sleeve somewhat, and it has been our experience that that clearance has to be a reasonable amount, particularly at the flare end of the cylindrical section of the sleeve, so that once a joint has been made up tightly and is subsequently disassembled, the nut is free to rotate on the sleeve, after the sleeve has been slightly expanded through this action.

The sleeve head angle, as noted here, shows that

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the [111] two surfaces I just mentioned are not exactly parallel, as initially made. We have made some checks on it, which indicate that, once the joint has been made, the sleeve is approaching closely to a true cylinder, after it has been expanded through this tension.

I might say that the question as to whether it is necessary or not can be boiled down pretty much this way, that you could have parallel surfaces on the outside of the sleeve, but it would necessitate, if you maintained the washer contact with the shoulder area, either a weaker nut or a larger diameter hexagonal nut, which in all cases is a six-sided hexagon so that it takes a wrench.

Q. 27. Would it be desirable to use a larger nut?

A. Definitely not. We are interested in keeping the weight down on our fitting assemblies which, I might add, in a modern airplane and even a small airplane, runs into, I think, roughly, somewhere between 500 and 1,000 pounds for similar connections in each plane.

Q. 28. And would it be desirable to make the nut weaker?

A. No. In designing our airplanes we want the following things: First, it has got to work and serve its purpose and, by "work," I mean not only work when you want it to work in the field and under maintenance conditions—that is its first main function. Second, it has got to be of a size so [112] that we can put it in the airplane, and, third, it has

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got to be as light as possible for the required function, and also it must be as cheap as possible. Everything in the airplane has to be weighed on the basis of those four functions.

Q. 29. And has the use of fittings of the kind exemplified by Plaintiff's Exhibit 2 (Amon deposition) served its function and worked satisfactorily?

A. Yes, it has served its function very well. We have used the type of fitting here, both AC-811 Parker type and the AN type, for as long as I have been in the business. We did not use the AN type until very late in the war.

Q. 30. Are you familiar with the smaller type fittings that provide a double angle on the inside of the sleeve that engages the outer surface of the flare? A. Yes.

Q. 31. And has your company used fittings of that kind?

A. Yes, both the AC-811 sleeve and the AN sleeve and, as it was initially issued, I believe it shows the same double angle in the smaller sizes.

Q. 32. The drawing or type of fitting that you have just referred to is of the kind illustrated in Plaintiff's Exhibit No. 8? A. Yes. [113]

Q. 33. Is it customary and desirable to connect and disconnect two fittings to accessories or operating parts on a plane?

A. Yes, it is very necessary, both at the time of manufacture and very often—by that I mean we either buy a piece of equipment and it has to

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be tested, preferably by the accessory manufacturer—very often we inspect it and double check it at our plant, and we have to assemble it and re-assemble it again, and we also check it in the fluid system of the airplane itself. They are removed and we check those before we put them together, with other auxiliary connections, to make sure that all the connections are tight, prior to the final assembly of the airplane. That is very necessary with manufactured products, because the assembly lines are quite short and we cannot spend the time to go over all the lines on an airplane; so in other cases where we had to make these connections and break them, also in the field where there is the maintenance of the airplane, we quickly had to assemble these connections or a number of them in order to get at something else or to replace an accessory or something of that sort, or to modify the airplane or something like that which we have to make or the Government wants us to make.

Q. 34. So that a fitting is used—— [114]

A. It is re-usable, I will put it that way.

Q. 35. And, when re-used, must serve as efficiently as when first used?

A. That is correct. Well, not used in combination with other material or fittings that necessitates the replacement of any of the metal parts, because that would be too costly in the field.

Q. 36. And, likewise, inconvenient?

A. Yes.

Q. 37. In the double angle fittings of the small

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size you have referred to, as illustrated in Plaintiff's Exhibit No. 8, is it true that the sleeve first engages the outer flare of the tube over a very narrow line of contact?

A. Yes, that is very necessary. If the first contact is made farther down the tube, it would tend to push the tube back through the sleeve to a certain extent and not provide sufficient contact area between the inside flare of the tube and the top cone.

Q. 38. You mentioned the torque tension. By that do you mean the expansion of the lower end or the nose end of the sleeve, as the nut is brought up to proper torque?

A. That is correct. In order to create a proper connection between the inside surface of the tube and the outside surface of the body, it obviously requires a tension [115] force in the sleeve adjacent to this binding or contact, and that produces a circumferential tension in the sleeve which, for lack of a better word, we will call hoop tension.

I would like to go back for a moment, if I may, for a little more discussion on this flare diameter of the tube.

Q. 39. Go right ahead.

A. If the flare diameter—and by "flare diameter" I mean the maximum diameter of the tube—if that is too large it interferes with sliding the nut over the assembly in making it up, and it is obvious that it has to be less than a certain dimension, and it also has to be greater than the point of contact with the sleeve. If it is approximately the same

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diameter as that corresponding edge on the inside of the sleeve, it will definitely drive the tube back out through the sleeve when the joint is made up to the extent where it will fly out.

We have had trouble with that, and have had cases where you could actually pull the tube out or it flies out, and of course that kind of a joint is no good, so in our manufacturing procedure and inspection we require that all tubes are checked with a "go-and-no-go" gauge, to insure that the maximum diameter of the tube flare is within proper limits.

Q. 40. Would you mind explaining what a "go-and-no-go" gauge is? [116]

A. That is a piece of steel that the tube won't go in and will go in. Each tube, after being flared, has to go in one hole and not in the other. We have been using that, to my personal knowledge, for at least seven years in production.

Q. 41. Mr. Bergh, you mentioned something about proper clearance or the angle between the lower or nose end of the sleeve and the nut. What would happen if the sleeve actually jammed or engaged tightly against the inner wall of the nut when you were ready to assemble the joint?

A. Well, two things could happen when making the joint up initially pretty tight; it might tend to rotate the tube slightly just before the nut was brought up to its proper tightening torque in relation to the tube, or if it did not rotate the tube on initial assembly, it is perfectly proper to twist the

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tube during the make-up torque of the nut, or if the initial clearance as mentioned is still closer, it is conceivable that the nut will not be able to be rotated at all without twisting the tube, in which case it will damage the tube and necessitate replacement of it with a smaller size.

The tortional stiffness of the tube is of course greater in small sizes, and this condition has never been brought to my attention except in the smaller sizes, because usually in [117] the larger sizes there is sufficient tortional strength in the tube itself to prevent other than a momentary rotation of the tube. Except for defective parts, we have never had this trouble in production that we have just discussed here, if the parts are made in accordance with the proper dimensions.

Q. 42. However, if the nut and sleeve had jammed to such an extent that they were both rotated in unison, could that score or ruin the flare on the tube?

A. Well, I think it is fairly obvious that in any such condition the forces between the tube and the sleeve will be higher than the forces between the sleeve and the nut, once it has been made up. Even if they are both bound, you would expect the forces between the nut and the sleeve to be less than between the sleeve and the tube, as far as tortional rotation or twisting is concerned. I might add that once the assembly has been made up, the sleeve has been brought into very intimate contact with the tube near the sealing surface in such a manner that

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usually, once the joint has been made up, it is impossible to move the sleeve away from the flare of the tube.

To answer the question perhaps a little bit differently, it would be highly undesirable, if the nut became to any degree part of the assembly and it would be impossible to [118] disassemble it, and I think that scoring of the surface between the inside of the sleeve and the conical section of the body would be less serious than the damage to the tube itself unless of course it is possible to rotate the other body end which could conceivably be done in some cases.

Q. 43. Putting it in another way it is highly desirable that the nut be easily removed without mutually removing or in any way disturbing the sleeve proper? A. That's right.

Q. 44. Are these fittings in airplanes used in portions of the plane that we might call close quarters?

A. Very close quarters.

Q. 45. And are they likewise used where there may be a great number of fittings closely adjacent to each other?

A. Yes, in order to get all fluid line assemblies in our airplane we very often have to gang them together into a package more or less and very often we go so far as to make up a bundle of tubes with these connections on them and slide them into the airplane. We make up these bundles, and still we have to provide access to them, so that a mechanic still can loosen one of these nuts. It can be done, but

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it is not as easy, when you have a bundle, as it was when you had a joint for each tube assembly and then put them in the airplane; but the point is, it can be done. [119]

We also like to be able to use torque wrenches, the Government has a requirement with respect to checking the torque on these kind of connections. It is not an ideal method of knowing that everything is perfect, but it is the best method we have. We endeavor to use it quite often, and the inspectors have to go in occasionally to see that the mechanics are properly tightening the connections. A connection may appear to be tight initially, but may loosen under the action of vibration or high pressure, if we don't give some inspection to the made-up joint.

Q. 46. In airplanes the safety of the plane and the proper functioning of the plane is, to a great extent, dependent upon a proper joint being made between the tube and the operating mechanism of the plane; is that correct?

A. Yes, I think that all the troubles we have with airplanes—and by "troubles" I mean big troubles, either serious damage to the airplane or loss of the plane or fire as a result of fluid line leaks—I would say that things such as these, and other relatively small things when you see them, are the cause—not only fluid line connections, but I mean spacing electric wires properly and putting insulation on them—things of that type I think are responsible for a lot more than fifty per cent, and I should say seventy-five per cent of the real troubles

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that we have on our airplanes, [120] aside from accidents due to the planes themselves. Putting it another way, airplanes do have accidents, and the majority of course are due the pilot's error or to the weather, but subtracting that kind of accidents, which are caused by either the pilot or the weather, improper information given to him over the radio or something like that—those are caused to a much higher degree than would be caused by the structural weakness of the airplane itself.

I might say that our own experience has been that, when we have an accident, ninety per cent of the time it is due to faulty installation rather than structural design, so it is the little things that make the big difference, and I have always found that if you lick the little things, they create the majority of our headaches.

Mr. Freeman: That is all. You may cross-examine.

Cross-Examination

By Mr. Beehler:

XQ. 47. You mentioned, I believe, Mr. Bergh, that you worked for a company called Fleetwings, Incorporated.

A. That is correct.

XQ. 48. What business were they in?

A. I thought I made it clear that I started in the aviation business when I left college. We were manufacturers, initially, of small components for other airplane manufacturers, [121] and we gradu-

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ally worked into assemblies of complete control devices and fittings for other manufacturers, and finally we built two or three different airplanes ourselves, one of which was put into production just as I left the company at Bristol, Pennsylvania, and our particular field was stainless steel construction, spot-weld stainless steel construction, which we pioneered in the industry.

XQ. 49. Did you have occasion to use two-piece fittings when you worked for Fleetwings, Inc?

A. Yes, we used them, but I frankly admit that I did not pay much attention to them at that time. I couldn't even be sure whether they were two-piece or three-piece fittings, but I know that we had used those at the time. Of course, I wasn't as well versed on the subject at that time, except that I believe we used what other airplane people used.

XQ. 50. Are you familiar with the two-piece flare fitting? A. Yes.

XQ. 51. When did you first become acquainted with the two-piece flare fitting?

A. Well, when I became acquainted with it is rather hard for me to answer. I distinctly remember that we started using—I don't know whether we actually used them or not, but I believe we did use some on our first airplanes that we made down there at Fleetwings. The only reason I remember [122] that is because I remember using a bunch of so-called NAF drawings which defined dimentionally the shape of the nut or sleeve, as you call it, which

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is one piece of metal required to be used on all Naval aircraft.

In addition to that, I distinctly remember something in connection with some other work that we had, which was the forerunner of the two-piece fitting. I don't know what the dimentional change was between that NAF and I believe what is called the AN-819, which is a similar looking fitting under the AN series.

XQ. 52. Are the two-piece flare fittings reusable?

A. To the best of my knowledge, they are, but I am not certain. As I say, since I left Fleetwings and came to what is now called Republic Aviation—it was then called Seversky Aircraft and was taken over by Republic in 1937 or 1938—we were always supposed to be required to use the three-piece type of fittings.

XQ. 53. Have you used the two-piece type of fittings yourself since you came to Republic?

A. No, sir, I don't know of a single instance where we have used the two-piece fittings.

XQ. 54. Republic Aviation does not supply any aircraft to the Navy, does it?

A. No. Frankly, I am not familiar with Parker's relation [123] to the two-piece fitting.

XQ. 55. I refer you, Mr. Bergh, to Plaintiff's Exhibit No. 2, and I wish that you would recall your testimony with regard to the contract between the sleeve shoulder and the nut shoulder. A. Yes.

XQ. 56. You stated, I believe, that the area of

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contact between those two shoulders is important; is that correct?

A. Yes, because of the force that makes the compressive connection between the inside of the flare of the tube and the body.

XQ. 57. Is that area critical?

A. Well, let's put it this way: Any time we find stresses that are too low, we have to do something about it. By that I mean our airplanes only perform on the basis of the strength-to-weight ratio, which is a very critical item that makes the airplane take off. If it is too heavy, it won't fly. You can make a very safe airplane by keeping the stresses very low but, unfortunately, the airplane will never take off, so we have to worry about the weight of the assembly.

As I say, I was very intimately connected with checking up the fittings, and we have to keep the dimensions to reasonable amounts and keep the weight down, and still serve [124] the functions that they have to serve. I believe I prefaced my opening statement that the thing has got to work, first; it has got to fit, be the lightest we can get, and cost the least. Those things are important things and not comparable to industrial applications, where weight doesn't make so much difference.

XQ. 58. Do you know what safety factor was recommended with respect to these two shoulders?

A. Well, two things enter into that. You have to keep the stresses down, so that fatigue, and so forth, will not take place. That is the low limit, and of course a certain amount of experience is a factor

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involved in these things. You cannot just say, arbitrarily, if the stress goes up from 15,000 to 20,000 pounds, that is all right, and if you go under 10,000, that is wrong. There is a certain amount of experience necessary in those things.

A number of tests were run by the Government and accessory manufacturers and airplane manufacturers, to make sure that these things would serve their function, with reasonably light weight. The cylindrical section of the sleeve was decreased from the original AC-811 type, and the original AN sleeve was decreased for normal use, and the only exception to that was in the length of the sleeve. I think the navy has one arrangement and the Army has another. I don't believe [125] they even call it AN.

XQ. 59. With respect to this Plaintiff's Exhibit No. 2, Mr. Bergh, note, please, the interior of the nut, the portion that surrounds the head of the sleeve. A. Yes.

XQ. 60. Suppose, for example, that the diameter of the interior portion were increased .004 of an inch. Would that necessitate increasing the outside diameter .004 of an inch to maintain a safe coupling?

A. Well, that is a hard question to answer. You say .004 of an inch, but I don't know what the taper is. I know that very careful studies of these were made by the Air Force of each size. I think they blew up pictures twenty or twenty-five times, and then they set up the AN dimensions in relation to the previous three-piece AN fittings, to stay within reasonable proportions of the prior art fittings.

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XQ. 61. These nuts are made up from standard hexagonal rods, are they not?

A. No, not standard hex rods, because we ran into trouble there, and just to show you the trouble we ran into, the chief producer of the hexagonal stock from which all nuts are made, so far as I know —it was found that the commercial tolerances were excessive, with regard to just a small thing like having a so-called standard wrench, to make sure that [126] either the parallel type of wrench or the box type of wrench would fit. We definitely ran into that trouble, and that necessitated setting up closer tolerances than the commercial stock.

XQ. 62. Let me interrupt you for a moment. What do you mean when you say that the hexagonal rod was not standard, so that it had to be made to closer tolerances than standard?

A. I mean that the maximum dimension had to be such that the wrench would fit without slipping.

XQ. 63. Those dimensions were standard commercial sizes, were they not?

A. No; so far as I recall, they were fractional dimensions.

XQ. 64. Isn't it true, Mr. Bergh, that the outside diameter of the hexagonal rod controls to a greater degree the clearance that is available——

A. Did you say maximum or minimum degree?

XQ. 65. Either one—that it has a greater effect on the clearance which in available to you than a matter of some .004 of an inch variation of the parts on the inside of the fitting?

A. Well, I would say that the tolerance, so far

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as I recall, measured across the flat surface of the hex, was probably wider. Perhaps some more light can be shed on the [127] question you have asked me if I say we have had trouble, particularly during the war, with two things in connection with defective materials: One, in the material out of which the sleeve was made. I believe we used exclusively in our company for years a copper silicon, and that type of sleeve we had always found would take the tension created better than the other materials, particularly in the small sizes. We had cases where cracks would form where the material was not properly processed.

I had occasion to attend various meetings of the Aeronautical Board and the Army and Navy where, during the war, they tried to force us to give up the use of copper silicon for sleeves. We had had this trouble, and we knew that if we changed to another basic material on the sleeves—by test we found we were having more trouble, so we, for one—and I believe other airplane manufacturers had trouble—so we decided that we definitely needed this copper silicon material, which is capable of taking the tension without cracking.

This cracking that I mention is something that would not necessarily happen the first time the joint was made up. We found cases where the joint was apparently tight and, on the first disassembly, we found it was cracked down through one line. In some cases that did not create a leak but, on retightening, it did. So the Government finally permitted us—although [128] it was a critical material

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—permitted us to use copper silicon for the sleeves. I mention this because it shows wear on the inner edge of the sleeve.

Now, so far as the nuts are concerned, I would say that almost 99 per cent of the nuts we use, except on flexible hose assemblies with an aluminum alloy type of nut, showed imperfections or defects in the hexagonal bar stock—and I think you had it, and we all had it. We had cracks like this (illustrating). Here is the hex shape of the bar, and at some point through here (indicating) we would get a crack.

XQ. 66. Some place across the bar?

A. That's right, yes, across the short dimension, we had trouble with cracks there, and it was found that there were either imperfections in the billet that did not show up until the nuts had been used or——

XQ. 67. The cracks did not have any relationship to the area of contact between the nut shoulder and the sleeve shoulder, did they?

A. Well, it is obvious that there are tension forces created in the nut as well as in the sleeve. Those tension forces are primarily due to the angle of the thread, and when you screw the nut up tight, it applies this force in such a direction that it tends to create a tension effect on the nut as well. I believe that the cracks we found there in the [129] nuts were primarily due to the spread effect. I don't have proof whether it was—we know it was defective material, I will put it that way—but whether it

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was the effect of the thread expanding or the expansion of the sleeve, actually I don't know. I think that was very much less likely to be the case; I think it was more likely to start at the free or open end of the hex nut and work back.

XQ. 68. Tell me in your own words, Mr. Bergh: Is a sleeve head angle such as illustrated in Plaintiff's Exhibit No. 2 necessary in order to have that coupling work successfully?

A. To be perfectly honest with you, I cannot say anything definite about that, because we have always used this fitting arrangement here (indicating), and the only way you can tell a thing like that is to have a lot of experience whereby you can determine that. A few isolated tests will not answer the question, Mr. Beehler. We have had cases where the parts stood up all right by test, according to engineering practice, analysis and specification, but gave trouble in service. All I can say is that I know these work and I believe, from the point of view of minimum weight and knowing that the sleeve will expand somewhat, that this (indicating) will be a little more efficient. That is as far as I can say.

XQ. 69. Do you recall, about the time that you first began [130] to work with Republic Aviation, whether or not the sleeves of the three-piece couplings then used had a sleeve head angle?

A. As far as I recall, yes. The only way I can answer that question is to say that the AC-811 sleeve that was in our standard book—they wouldn't permit you to manufacture any of the standard fittings

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and, as we had to do something, we obtained the dimensions of the AC-811 fittings from the Parker Appliance Company, and I think I still have a set of the things. I brought them along with me in my brief case and I could check them, if you want me to. I have dimensions on the drawings here, but my best recollection is that they were——

XQ. 70. Just a minute. Do you recall the first of those drawings, without looking at them?

A. No.

XQ. 71. Will you look at them, please, Mr. Bergh?

A. I recall a bulletin about these things, telling the company how to use these things, back in 1943, when they first came out. This drawing here, of which I have copies, is dated October 25th and shows a 1½ degree angle on the cylindrical outside surface of the sleeve.

XQ. 72. And that is a drawing which is identified as 811-T, I believe. [131]

A. 811-T, yes. Actually, these drawings here were not issued by the Army Air Force, they were issued by the Parker Appliance Company, and I believe were distributed through the Army Air Force to anybody who wanted to make these fittings, because the 811 drawing sheet was inadequate to show the dimensions of the various pieces.

XQ. 73. I will ask you, Mr. Bergh, whether those drawings are the earliest drawings you have in your possession here.

A. These are the only drawings that I have of

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the so-called AC-811 type of fitting. If anybody has an AN book here, showing the 811 sheet, I could show you what I mean.

XQ. 74. No, that is not necessary.

A. It is one piece of paper the size of this (indicating), which is supposed to give all the necessary engineering information for all the AC fittings that the Army had in effect. There may have been sixty or eighty fittings on that one piece of paper.

XQ. 75. Did you use any three-piece couplings prior to the time that the AC-811 specifications were promulgated?

A. The AC-811 sheets, they were in our standard book as far back as I can recall. I don't know the initial date of issue. Has anybody got that book here? I could certainly identify it, if they have. I am almost absolutely certain that the original AC-811 sheet did not show these [132] dimensions or any other manufacturing dimensions of the AC-811 fitting. You can answer that better than I can. The only dimensions that I recall on the 811 sheet were more or less installation dimensions.

XQ. 76. Mr. Bergh, may I suggest that if you will just kindly answer the questions and not continually volunteer, we might be able to shorten the record and save considerable time here?

A. Yes, sir.

XQ. 77. Let me ask you this question, Mr. Bergh: From about 1935 until, let us say for example, 1937 did you experience any difficulty with the

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head of the sleeve of the three-piece coupling seizing the nut, as the nut was backed off the fitting?

A. When I was first employed at what is now called Republic, I was in the structures end of the company and, until I became an engineer, which was around 1939, I was not in that end of the business to be able to honestly answer your question.

XQ. 78. In 1939, then, did you have any experience with the sleeve head sticking in the nut as the three-piece coupling was uncoupled?

A. No, sir, I cannot say that I recall any trouble with the fittings until considerably later than [133] that.

XQ. 79. Subsequent to the adoption of the AN standard dimensions for the three-piece fittings, Mr. Bergh, have you experienced any sticking of the head of the sleeve in the nut?

A. All I can say is that it has not been brought to my attention.

XQ. 80. Along about 1939 or 1940, Mr. Bergh, namely, your first experience with the three-piece flared fitting, you recall, do you not, that the nut shoulder, as that part is labeled on Plaintiff's Exhibit No. 2, was not perpendicular to the axis of the nut but, rather, tilted at a slight angle; is not that so?

A. You mean this surface here (indicating)?

XQ. 81. The surface of the interior of the nut shown on Plaintiff's Exhibit No. 2.

A. Was not a flat surface?

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XQ. 82. Was a flat surface, but tilted with respect to the axis of the nut?

A. It couldn't be a flat surface; it had to be a conical section.

XQ. 83. Well, was it a conical section?

A. I cannot answer that. I would have to look up and check the drawings I have here.

XQ. 84. You said, I believe, that it was desirable, Mr. [134] Bergh, not to have the tube rotate when a coupling is disassembled. A. Yes.

XQ. 85. Have you had occasion to disassemble two-piece couplings?

A. No, sir; I said I have had no experience with two-piece couplings. I have never used them, and I couldn't say.

XQ. 86. You stated, Mr. Bergh, I believe, that you were a member of Committee A-3 of the S.A.E.

A. That is correct, I was, at the time the bulletin was written that you have in your hand there.

XQ. 87. Do you subscribe to this statement which I read from page 1 of the bulletin entitled "S.A.E. Aeronautical Information, Report No. 1:"

> "b. Sleeve Nuts: The AN-817 sleeve nut is interchangeable with the AN-818 nut and AN-819 sleeve combination. However, tests show that the nut and sleeve combination will permit closer tube bend, more repeated disassembly and reassembly and more wrench torque."

A. Could I see that, myself?

XQ. 88. Certainly (handing to witness).

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A. Yes, I believe that the statement which says "that the nut and sleeve combination will permit closer tube bend, more repeated disassembly and reassembly and more wrench [135] torque" is a true statement of the facts.

XQ. 89. Thank you, Mr. Bergh. When that recommendation was made which I just read to you, do you recall who made the tests which accounted for that recommendation?

A. No, sir, I cannot answer that. The only way I can answer your question is to state, by inference only, because the Air Force wanted us to use the three-piece fittings and insisted upon it, and I say by inference only, because of that fact. It is more expensive, I believe, for a three-piece instead of two, but as long as we were making the airplanes, we had to follow their specifications and use the three-piece fittings instead of two-piece fittings.

Mr. Freeman: Are you going to put this bulletin in the record, Mr. Beehler?

Mr. Beehler: I can, if you wish. Now may we have a couple of minutes recess, Mr. Freeman?

Mr. Freeman: Certainly.

(Whereupon a short recess was taken.)

XQ. 90. One more question, Mr. Bergh, with regard to this same S.A.E. Committee A-3 report, page 1 of which I previously referred to. It is true, is it not, that the AN-817 sleeve nut mentioned in that paragraph is a sleeve nut which is used exclusively with a two-piece flared fitting?

A. Yes. [136]

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XQ. 91. Then would you like to clarify your previous statement to the effect that you had had no experience at all with the two-piece flared fittings?

A. To my personal knowledge, we have never put in the AN-817 sleeve nuts.

XQ. 92. You stated, I believe, that you, yourself, had never used the two-piece coupling. Is that still your statement?

A. Yes, sir. If that is a fact, it is something that I am not at all aware of, and it would be contradictory to Government specifications for an Army airplane. It is true that deviations are granted by the Government in special cases, and perhaps in isolated cases we may have asked the Government to permit the use of an AN-817, but I can say truthfully that for the last two and a half years at least, all the correspondence that comes in to the company and goes over my desk would so indicate, from just quickly glancing at the letters, but I am not saying it didn't happen.

Mr. Beehler: That is all.

Mr. Freeman: Are you willing to waive the reading and signing of the testimony by the witness?

Mr. Beehler: Yes, that is agreeable.

Mr. Freeman: Thank you very much, Mr. Bergh. That includes the taking of depositions in New York. [137]

At this time I am going to ask you, Mr. Beehler, to send me a photostat of the cover page of that

bulletin entitled "S.A.E. Aeronautical Information, Report No. 1" and the particular page a portion of which was read into the record, with the understanding that the bulletin will be made available to counsel for the plaintiff at a later date, if necessary.

Mr. Beehler: That is satisfactory.

Signature waived.

(Whereupon, at 11:25 A.M., May 11, 1949, the foregoing depositions were [138] concluded.)

State of New York,
County of New York—ss.

I, Irwin T. Shaw, a Notary Public and Certified Shorthand Reporter of the State of New York, do hereby certify

That the foregoing depositions of W. Howard Ehmann, William D. Clark, and Edward M. Greer were taken on behalf of the plaintiff in these actions pursuant to notices dated April 6, 1949, before me at the offices of Messrs. Cravath, Swaine & Moore, 15 Broad Street, New York 5, N. Y., on Tuesday, May 10, 1949, between the hours of 10:00 A.M. and 4:15 P.M.

That the said witnesses were by me duly sworn before the commencement of their testimony, which was recorded by me stenotypically and thereafter reduced to typewriting under my direction; and that the foregoing transcript constitutes a true and correct record of the proceedings herein.

That the parties to these actions were represented

at the taking of said deposition by counsel as set forth in the list of appearances.

That pursuant to stipulation the reading and signing of the depositions by the witnesses are waived, and

That I am in no way whatsoever related to or associated with either of the parties hereto or their attorneys, nor am I interested directly or indirectly in the matter in controversy.

In Witness Whereof, I have hereunto set my hand and affixed my official seal in the City, County and State of New York this 20th day of May, 1949.

[Seal] /s/ IRWIN T. SHAW,

Notary Public in the State of New York. [139]

State of New York,
County of New York—ss.

I, James W. Maxwell, a Notary Public and Certified Shorthand Reporter of the State of New York, hereby certify

That the foregoing deposition of Roland C. Bergh was taken on behalf of the plaintiff in these actions pursuant to notices dated April 6, 1949, and adjournment from May 10, 1949, before me at the offices of Messrs. Cravath, Swaine & Moore, 15 Broad Street, New York 5, N. Y., on Wednesday, May 11, 1949, between the hours of 9:30 A.M. and 11:25 A.M.

That the said witness was by me duly sworn before the commencement of his testimony, which was recorded by me stenographically and thereafter

transcribed; and that the foregoing transcript constitutes a true and correct record of the proceedings herein.

That the parties to these actions were represented at the taking of said deposition by counsel as set forth in the list of appearances.

That pursuant to stipulation the reading and signing of the deposition by the witness is waived, and

That I am in no way whatsoever related to or associated with either of the parties hereto or their attorneys, nor am I interested directly or indirectly in the matter in controversy.

In Witness Whereof, I have hereunto set my hand and affixed my official seal in the City, County and State of New York this 20th day of May, 1949.

[Seal] /s/ JAMES W. MAXWELL,
Notary Public, State of New York.

[Endorsed]: Filed June 22, 1950. [140]

PLAINTIFF'S EXHIBIT No. 12

In the District Court of the United States, Southern District of California, Central Division

Civil Action No. 7874-B

THE PARKER APPLIANCE COMPANY,

Plaintiff,

vs.

IRVIN W. MASTERS, INC.,

Defendant.

NOTICE OF TAKING DEPOSITIONS

To: Vernon D. Beehler, counsel for Defendant, Irvin W. Masters, Inc.

Please Take Notice that the Plaintiff, The Parker Appliance Company, by its attorneys, Bair & Freeman, will take the deposition of the party Defendant, Irvin W. Masters, Inc., by its agent and officer, Irvin W. Masters. The deposition will take place at 1:30 p.m. on July 11, 1949, at the offices of Lyon & Lyon, 811 West Seventh Street, Los Angeles 14, California, before an officer duly authorized by law to take depositions. You may attend and cross-examine if you see fit to do so.

LYON, LYON, CHARLES G. LYON,

Attorneys for Plaintiff.

Of Counsel:

/s/ WILL FREEMAN,

/s/ W. M. VAN SCIVER.

Plaintiff's Exhibit No. 12—(Continued)

June 28, 1949.

Proof of service attached.

In the District Court of the United States for the Southern District of California, Central Division.

Civil Action No. 7874-B

THE PARKER APPLIANCE COMPANY,

Plaintiff,

vs.

IRVIN W. MASTERS, INC.,

Defendant.

Deposition of Irvin W. Masters, taken on behalf of plaintiff, at Suite 800, 811 West 7th Street, at the offices of Lyon & Lyon, Los Angeles, California, at 1:30 o'clock p.m., July 11, 1949, before W. E. McClure, a Notary Public within and for the County of Los Angeles and State of California, pursuant to the annexed notice of taking depositions.

Appearances of Counsel:

LYON & LYON, Esqs.,
CHARLES G. LYON, ESQ., and
BAIR & FREEMAN, ESQS.,
WILL FREEMAN, ESQ.,
For Plaintiff.
VERNON D. BEEHLER, ESQ.,
For Defendant.

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

IRVIN W. MASTERS

having been duly affirmed, testified as follows:

Direct Examination

By Mr. Freeman:

Q. You are Irvin W. Masters, president of the Irvin W. Masters, Inc.?

A. Irvin W. Masters, that is right.

Q. Have you produced, or do you have with you drawings requested by motion?

A. I do, in the main, Mr. Freeman. Some items, we have used drawings not specifically called out, namely, in some cases we used the same drawings for aluminum that are—used the aluminum drawings for making steel or brass or copper silicon parts.

Q. And whether made out of aluminum or other metals the drawings with respect to dimensions are the same? A. In some instances, yes.

Q. Will you please produce the drawings that you have available in response to the motion?

(A discussion was had off the record.)

Q. (By Mr. Freeman): Now, Mr. Masters, you have produced two sets, or a duplicate set of drawings in a file which is marked "Active"; that is correct, is it not? A. That is correct. [2*]

Q. And you have likewise produced a file of drawings represented by blueprints, about 25 in

***Page numbering appearing at top of page of original Certified Transcript of Record.**

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

number, which are marked "Inactive," and of which you have only one set?

A. That is correct.

Q. And it is my understanding that you want the prints returned to you, so that I am going to ask that a duplicate set of photostats be made by you or your attorney and furnished to the plaintiff at plaintiff's expense. That is agreeable, is it not?

A. That is agreeable.

Q. And I understand further that you have been searching for drawings, those that were specifically requested, and you have produced those that you have found up to date, and that there may be perhaps other drawings requested which if you do find you will make them available to us as soon as possible?

A. That is correct, other inactive drawings.

Q. Now, Mr. Masters, you have been requested to produce catalogs or literature with respect to fittings, and have you checked your records, and have you produced such literature?

A. I have here copies of everything now available. I believe that there have been lists produced in the past which are not now extant, but this covers the bulk of what we have turned out.

Q. And the literature that you have here produced, [3] do I understand that we may retain it, keep these copies? A. That is correct.

Mr. Freeman: I take it, Mr. Beehler, at the trial you will not question the production of any of these

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

documents, and that we may offer them in evidence without any further proof as matter put out by Irvin W. Masters, Inc.?

Mr. Beehler: That is satisfactory.

Mr. Freeman: And that the same applies with respect to the active prints and the inactive prints which have been furnished and which will be furnished us by Mr. Masters or the Masters Company, right?

Mr. Beehler: That is correct.

Q. (By Mr. Freeman): Now, Mr. Masters, where is your plant located?

A. 1060 North Lake, Burbank.

Q. Will you tell me when you started in the fitting business, as a manufacturer of fittings?

A. Well, about May, 1941.

Q. And you started at about the time that our country was in its so-called preparedness program?

A. That is correct, as a manufacturer. I sold fittings prior to that.

Q. As a manufacturer I understand you started in 1941, and is it correct that your principal efforts were directed to fittings applicable to the aircraft industry? A. That is correct. [4]

Q. And is it likewise correct that your attention from 1941 on down to substantially the present date has been with fittings directed to the aircraft industry? A. In the main, yes.

Q. Are you familiar with the aircraft fittings commonly known as the Parker type?

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

A. Those are the ones designated as the 811 fittings, I believe. Yes.

Q. You know as a fact that they have been referred to and are referred to as the Parker type fitting?

A. Yes, they are quite generally known as Parker type fittings.

Q. It is a fact that you personally have referred to such fittings by the name "Parker type"?

A. Well, I have no knowledge of so referring to them in any of our sales literature, if that is what you mean.

Q. Well, aside from sales literature, in conversation with customers and prospective customers have you referred to fittings of the kind here involved as the "Parker type"?

A. Well, I have avoided such reference as much as I could, because we were interested in Masters' fittings, but when people spoke of "Parker type fittings" I knew what they were, and everybody does.

Q. And you sold Masters fittings when people or customers referred to them as Parker type, correct? A. That is correct. [5]

Q. Is it true that in correspondence that you have carried on with the Air Materiel Command at Wright Field reference was made to Parker type fittings in such correspondence?

A. I don't know.

Q. You did have, of course, correspondence with

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

the Industrial Resources Branch and Requirements Branch of the Production Resources Section, Materiel Center, Wright Field?

A. I don't just recall that description, but that fits the sections which had such functions as the name described there, yes.

Q. The functions of the section that I have just described, whether by that name or one closely simulating it, you answered correspondence when they asked you about your capacity for the manufacture of Parker type fittings?

A. Yes. However, they were most frequently designated by the accepted Government numbers, 810 and 811—811, primarily.

Q. And likewise by——

A. There were other designations.

Q. Such as AN?

A. And the AN, yes, that is right.

Q. And it is a fact that during the war you did make available to the Materiel Command at Wright Field your production possibilities?

A. Yes. [6]

Q. Now, I understand that you began manufacturing fittings some time after the summer of 1941?

A. No—well, in the late spring of '41.

Q. You were going at full force in the year 1943? I just picked that out as sometime after——

A. Late '43 was in peak production, yes.

Q. And you continued manufacturing the same

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

fittings in 1943 that you started with in the spring or summer of 1941, correct?

A. The same type. There was a great many more items.

Q. In other words, your line expanded by 1943?

A. Very substantially.

Q. Then let's take 1945. You made the same type of fittings or the same kind of fittings in 1945 that you made in 1943? A. Yes, the same type.

Q. And the same answer, I take it, applies to 1947, right on up to date?

A. That is correct.

Q. Except at the present time I understand that there is less quantity? A. That is right.

Q. It is true, is it not, that in 1943, if you will recall, you received drawings from The Parker Appliance Company with respect to Parker type fittings?

A. I think likewise that is true in a few [7] instances.

Q. Do you recall under date of August 12, 1943, receiving a set of drawings from Parker Appliance Company with prints attached? By "prints" I have reference to blueprints or shop prints, dimensional drawings.

A. Well, I don't recall specifically that date. The principal drawings that we received on the 811 fittings was a set of drawings sent to us by the Air Corps.

Q. That was of the Parker type?

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

A. That was of the 811 type, which you refer to always as the Parker type.

Q. Did you say I refer to it always?

A. That is correct.

Q. And it is likewise true that the industry referred to them as the Parker type, too?

A. Not invariably. It is a good deal like the name Stillson. Just when people think of a pipe wrench they think of Stillson, and Parker was just in our hair so much, why, that was the quickest way to say it.

Q. Do you recall, Mr. Masters, receiving a complete set of 811 prints from The Parker Appliance Company in December of 1943?

A. No, I don't recall that.

Q. You were on the Independent Advisory Committee with regard to fittings, were you not, during the war? A. That is right.

Q. Does it refresh your memory when I tell you that [8] you had some conversation with a Mr. Amon of The Parker Appliance Company with respect to the 811 fittings?

A. Well, we had many such conversations. The 811 fitting was used quite extensively during the period of time that we were having those committee meetings, and they were discussed a lot, yes. I am not saying that we did not receive the drawings, because we were all operating with a great deal of freedom then, and each gave the other anything they asked for, and I know that drawings were received,

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

but I was under the impression we got them mainly through the Air Corps.

Q. Do you still have your correspondence available for say the year 1943?

A. As far as I know we have all of our correspondence, yes.

Q. I am wondering, Mr. Masters, if you would look up a letter from The Parker Appliance Company to you dated August 12, 1943, and also a letter to you from The Parker Appliance Company dated December 3, 1943, with respect to prints attached to the letters, and permission granted by The Parker Appliance Company, which permission was to terminate on cessation of hostilities?

A. I will look it up.

Q. And likewise you will have such letters available at the trial?

A. Yes, if they are in our files.

Q. Now, you have continued after the cessation of [9] hostilities to commercially sell airframe manufacturers fittings of the kind you sold to such airframe manufacturers during the war; correct?

A. Yes.

Q. And you now sell such fittings?

A. That is right.

Q. And you sell them to anyone who wants to buy them?

A. That is right, who has a record of paying for them.

Q. Just for the record's sake, you were present

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)
during the taking of the testimony of Amon and Davies in Cleveland, Ohio, and likewise during the taking of testimony in New York City?

A. That is right.

Q. You understand, do you not, Mr. Masters, that the suit brought by Parker Appliance Company involved only Parker Letters of Patent No. 2,212,183?

A. No, that is not my understanding. I know that was the patent number called out, but I considered it involved two previous patents, the numbers of which I do not recall, but which are named in that patent itself.

Q. Just so the record is straight, when the suit was filed, that is, the complaint filed by The Parker Appliance Company, you were charged with infringement of only Letters Patent 2,212,183?

A. That is correct, but that patent is in its [10] specifications described as an improvement of two previous patents, and I personally considered it so involved—them so involved.

Q. When you refer to the two previous patents being mentioned in Patent No. 2,212,183, I assume you are referring to the first paragraph of the patent wherein reference is made to "The present invention relates to new and useful improvements in tube couplings, and more particularly to improvements in couplings for clamping the flared ends of metal tubes such as are typified in U. S. Letters Patent to Arthur L. Parker, 1,893,442 and 1,977,240

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

of January 3, 1933, and October 16, 1933, respectively"; correct? A. That is correct.

Q. And your counterclaim for declaratory judgment filed in this case is directed to Patent Nos. 1,893,442 and 1,977,240; correct?

Mr. Beehler: That is correct.

The Witness: Right.

Q. (By Mr. Freeman): Now, Mr. Masters, will you tell us what threats were made by The Parker Appliance Company against you or any of your customers with respect to the 1893 and the 1977 patents?

A. I don't like the sound any more than you do of the word "threat," but there were letters written to various airframe companies and to ourselves by The Parker Appliance Company, in which you have stated that—The Parker Appliance [11] Company stated that the permission to use the Parker patents publicly had been withdrawn, and that The Parker Appliance Company now found it necessary in the regular course of business to assert those patent rights, and we and our customers regarded that as an indication that you were going to bring legal action.

Q. You never received any letter charging your company with infringement of either Patent 1893 or 1977, did you?

A. The reference is to the two later—two earlier patents?

Q. Yes.

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

A. I do not recall those numbers being specifically called out. Your communication to us stated that your legal department regarded that we were infrnging Patent No. 2,212,183 and other patents. We asked for information as to the other patents and what the infringement was, and you stated—you answered, stating that you would respond to that later, but we never got any response.

Q. In fact, you were never threatened under Patent No. 1893 or No. 1977 by The Parker Appliance Company?

A. Well, we felt that there was an implied threat, because of the patents being tied together.

Q. Is that the reason for your declaratory judgment counterclaim?

A. Not altogether. Your license agreements executed with other companies and license agreement proposed to us [12] called out all three patents.

Q. Now, you have mentioned that your customers were threatened. Was that also by an implied threat of the kind that you just referred to in your preceding answer?

A. Not specifically. The Parker Appliance Company wrote the airframe manufacturers asserting the Parker alleged patent rights.

Q. Under patent number 1893 and 1977?

A. I only have definite knowledge that you referred to Patent 2,212,183 and other patents.

Q. You do not have any definite knowledge or any letters or concrete evidence with respect to the 1893 and 1977 patents, do you?

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

A. Yes, I have such letters in my file of previous years, dating back for 13 years. Parker has—The Parker Appliance Company has frequently essayed to assert its patent rights.

Q. Since you entered the manufacture of fittings in 1941 have you any correspondence or any concrete evidence with respect to any assertion of either 1893 or 1977 patents against you as an individual, or your company, which bears your name?

A. I believe not as to those specific numbers, but since the letters referring to Patent 2,212,183 referred to other patents also, we always associated these two other patents that are called out in 2,212,183. [13]

Q. And that was the basis of your allegation in Paragraph XXVII "That upon information and belief plaintiff, by its agents, officers, employees and other persons responsible for its actions, has repeatedly and on many occasions openly and avowedly accused the defendant of infringing each and every one of the patents numbered 1,893,442, 1,977,240 and 2,212,183 and all the claims thereof"?

A. You are aware, Mr. Freeman, I believe, that your salesmen and representatives have consistently through the years, even the war years, and persistently called attention to Parker's patent rights, and our counterclaim there——

Q. Now, I want to know the name of the salesman or representative or employee of The Parker

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

Appliance Company that "on many occasions openly and avowedly accused the defendant of infringing each and every one of the patents"—the three were mentioned—"and all the claims thereof."

A. Well, I would like to not be confined by this answer to these two alone, but I know that Fred Amon and Bob White have made such assertions, or such have been reported to me, and, in fact, statements to me by them.

Q. You are testifying now under oath that the two gentlemen that you have mentioned in your preceding answer have openly and avowedly accused the defendant, and that is the Irvin W. Masters, Inc., of infringing 1893 and 1977 patents?

A. Well, I consider that I ought not to make reference [14] specifically to those two patents. It was often told that we were infringing across the board, and so, so far as the public is concerned and the industry, these patents which were extant previous to 2,212,183 were the ones regarded as being asserted from time to time by The Parker Appliance Company, and these men, as well as Mr. Parker himself, often told us that we would have our ears slapped back when the emergency was over. It was known that I had not personally received a license from The Parker Appliance Company, and had taken the position that I did not want a license. Many conversations in these Aircraft Scheduling Committee meetings to the effect that we were just tolerated momentarily.

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

Q. You had no trouble getting any prints of the Parker type fittings from the Parker Company when you wanted them with respect——

A. We had considerable trouble.

Q. With respect to the war effort?

A. Yes, we had considerable trouble.

Q. Go ahead and tell us a little bit about this considerable trouble that you had, give us the names of the individuals you had the trouble with?

A. Trouble? Just didn't get a response to our requests for drawings.

Q. Were those requests made in writing?

A. I believe they were. I think I can produce letters and I think I can produce some negative responses [15] too.

Mr. Freeman: I am going to ask that you do make available to us within a reasonable time after the close of these depositions photostatic copies of any of your requests to The Parker Appliance Company, as well as the responses that you received from The Parker Appliance Company, and again we will pay for the cost of such photostats.

(A discussion was had off the record.)

Q. (By Mr. Freeman): Now, Mr. Masters, we asked that you produce, I think, Size 4 and Size 8 fittings of the kind that you manufacture of these various materials. Now, have you produced such fittings?

A. I have. I have produced fittings which I trust will serve your purpose. My reason for so

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

responding is that we haven't given you exactly what you wanted or asked for, because we didn't have them. In the AN 4 size aluminium fitting with aluminum nuts and copper silicon sleeves, we have given you just what you asked for. In the 8 size we only had two complete assemblies to offer you, that is, in the AN fitting, and we have substituted a brass nut in one assembly. On the AN fittings which you requested that we supply with steel bodies and steel nuts and copper silicon sleeves, our face is red, in that our stock contained no steel nuts. We have supplied steel bodies, steel nuts and copper silicon sleeves, which we hope will do the trick. I am surprised that our stock was so short. [16]

Mr. Beehler: A question on the record. You said "steel bodies" and you meant "aluminum nuts"?

The Witness: They asked for——

Q. (By Mr. Freeman): Steel all the way through.

A. Steel bodies and steel nuts, and we are supplying not steel nuts but aluminum nuts, and copper silicon sleeves. Shall I proceed?

Q. Yes, go ahead.

A. On the 8 size AN fittings we had only stainless steel bodies and brass nuts and copper silicon sleeves. I believe you are aware that our principal business is making bodies in the shapes as a screw machine product manufacturer. On the 811 fittings

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)
we have only one assembly in the 8 size exactly as you asked for, because we had only had one aluminum BT8 size. There are, however, two after 8 size assemblies with cadmium plated brass nuts. On the 4 size 811 fitting we have supplied the sample as you asked for it. Peradventure you want some 4 and 8 size sleeves, as you mention them in aluminum, and there is no extra charge.

Q. Thank you, Mr. Masters, and now let me ask you if the sleeves, nuts and bodies that you have here produced are of your manufacture?

A. That is right.

Q. And when I say "your manufacture" we are talking about the defendant here, Irvin W. Masters, Incorporated. [17] A. That is correct.

Q. And the units manufactured by your company bear the initials or the trade-mark of your company, IWM?

A. Well, either that or a squiggle, which was a registered mark. I say a "squiggle." It was the IWM run together so that it looked like a bunch of static.

Q. Then my statement is correct——

A. That is right.

Q. ——that the products that you have here produced, that is, the fittings, include your initials of your company name or a trade-mark which is the equivalent of your company?

A. I believe that is correct, yes.

Q. Now, Mr. Masters, you have carried on corre-

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

spondence with other manufacturers and referred to a group of manufacturers of fittings as "Independent Manufacturers." Will you please explain to me what you mean by "Independent Manufacturers"?

A. Well, other than those in the Cleveland circle.

Q. Well, now, I am going to have to be enlightened as to what you mean by "the Cleveland circle."

A. Well, whether it is true or false, it is my belief that Parker Appliance Company and The Weatherhead Company have a—either a gentlemenly or ungentlemenly agreement, I don't know which, which we fellows out here on the Coast haven't enjoyed in the main, and that The Aircraft Fitting Company is operating under sort of an immunity from Parker's [18] infringement threats.

Q. Are you in effect saying then anyone manufacturing outside of a license under the Parker patents are companies that may be called independents?

A. That is right, rather loosely referred to, yes.

Q. Well, now, when you say "loosely referred to" you mean you loosely refer to companies other than Parker's licensees as independent?

A. That is right.

Q. And there are a lot of such industries here on the West Coast? A. That is right.

Q. What are some of these companies that you call independent manufacturers here on the West

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

Coast? Can you quickly give us the names of some of them?

A. Yes, the people I had in mind were Sanford Company, Gideon & Ramey, Pacific Piston Ring, Rogerson Engineering, Carruthers & Fernandez.

Q. Would that include the Durite Manufacturing Company? A. I don't know them.

Q. Would that include the Elmore Engineering Company?

A. I didn't have them in mind.

Q. These companies that you mentioned, you were in the manufacture of fittings ahead of those companies; is that correct? [19]

A. That is correct.

Q. In other words, they followed along as a result of the war or the demand for fittings during the war period, correct?

A. Well, I don't know how early Gideon and Ramey and Carruthers & Fernandez got into it. I am aware that Pacific Piston Ring and Rogerson Engineering were in it during the war.

Q. And got into it after you had already started the manufacture of fittings?

A. That is correct. Lest some misunderstanding or twist might be given to my testimony as to not having Elmore Engineering in mind, Elmore was a subcontractor of ours during the early part of the war.

Q. A subcontractor of the fittings of the kind here involved? A. That is right.

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

Q. And they made fittings of the kind that you have here produced, of that general makeup?

A. That is correct.

Q. It is true that you had a meeting of the so-called independent manufacturers at the Jonathan Club in the middle of January, 1948; correct?

A. It is true we had a meeting. I don't recall the date.

Q. That was shortly after suit was filed in [20] this case; correct?

A. I presume that is correct. I do not have an independent recollection of the dates.

Q. It is true that you wrote letters to customers and prospective customers that the independent manufacturers were going to support you financially?

A. That is right.

Q. And it is true that when you in such letter referred to independent manufacturers you were then talking about the companies that were not Parker licensees? A. That is correct.

Q. And you were then talking about companies the names of which you gave us just a few minutes ago? A. That is right.

Q. I do not recall whether you mentioned the name Collins Engineering Company as one of the so-called independents?

A. I did not, but it is true that they were at the meeting referred to.

Q. The letter that you sent out with respect to

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

being supported financially, that was a form letter, was it not? A. That is correct.

Q. And it was sent to many of the users of aircraft fittings of the Parker type; correct?

A. That is correct. [21]

Q. And you have a copy of the letter that you sent out, the form letter dated January 19, 1948?

Mr. Beehler: I object to the question as being entirely immaterial to the issues, and I direct the witness not to answer.

Mr. Freeman: Will you agree with me, Mr. Beehler, permit me to ask that same question for a ruling on the part of the court during the trial?

Mr. Beehler: Surely.

Q. (By Mr. Freeman): Did you, in fact, receive any financial support from any of these so-called independents?

Mr. Beehler: I object to the question on the same grounds as stated before, and direct the witness not to answer.

Mr. Freeman: And with the same understanding?

Mr. Beehler: Yes, sir.

Q. (By Mr. Freeman): Did you have any correspondence with The Kohler Company of Kohler, Wisconsin, with respect to soliciting financial support?

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): I am going to ask you, Mr. Masters, to produce a copy of the form letter

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

that you sent out on January 19, 1948, and particularly the letter that you sent at or about the same time to The Kohler Company of Kohler, Wisconsin, and the reply you received from The Kohler Company.

Mr. Beehler: Same objection and same direction. [22]

Mr. Freeman: And with the same understanding?

Mr. Beehler: That is true.

Q. (By Mr. Freeman): I am going to ask you, Mr. Masters, what you meant in your letter of January 19, 1948, the form letter, wherein you stated "We are writing you to call your attention to the necessity of certain action on your part if you do not want to return to the old condition where you were dependent upon a single source or sources controlled by a single producer of tube fittings"?

Mr. Beehler: I want to object to that on the ground that there has been no such letter produced, and direct the witness not to answer, and, in any event, it calls for an opinion and not a question of fact.

Q. (By Mr. Freeman): You recall including such a paragraph in a letter you wrote on January 19, 1948?

Mr. Beehler: I object to the question as entirely immaterial, and direct the witness not to answer.

Q. (Mr. Freeman): I am going to ask you

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

again what you meant when you said that "there was the necessity of certain action"? I want to know what you meant by "certain action"?

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): I am also going to ask you if you recall in your letter of January 19, 1948, writing "We are being supported financially and otherwise in this defense by a number of fitting manufacturers"? Do you recall, first, such a sentence in the letter of January 19, 1948? [23]

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): You refuse to answer?

A. I refuse.

Q. Mr. Masters, I hand you a letter which purports to have a signature thereon, and I will ask you to state whether or not that is your signature?

Mr. Beehler: I object to the introduction of the letter on the ground it is immaterial.

Mr. Freeman: I haven't introduced it. You can wait a moment. I am just asking him whether it is his signature.

The Witness: It is my name. That is not my signature.

Q. (By Mr. Freeman): Do you recognize it as the signature of your secretary?

A. Yes, that was sent out of our place all right.

Q. And it was sent out by the Irvin W. Masters, Inc., the defendant here? A. That is right.

Q. And it is a letter consisting of two pages, the

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

first page of which is on the letterhead of the Irvin W. Masters, Inc.; correct?

A. What about it, Mr. Lawyer?

Mr. Beehler: You may answer.

The Witness: Yes, that is right.

Q. (Mr. Freeman): The form letters that you sent out under date of January 19, 1948, were in the form and words and figures as illustrated on the letter that I have just handed [24] you, which you have identified as used by the defendant here, Irvin W. Masters, Inc.? A. That is right.

Q. I now ask you whether or not letters of that kind were sent out with your authority and under your direction? A. Yes, they were.

Q. And the letters of that kind were dictated by yourself? A. That is right.

Q. And you likewise designated the names of the customers or prospective customers or manufacturers to whom such letter was to be sent?

A. Yes, I had knowledge of where they went to.

Mr. Freeman: I am going to ask the notary to merely mark the two sheets of the letter of January 19, 1948, with his initials and the date, so that the same may be offered in evidence during the trial, unless Mr. Masters produces the copies which were heretofore requested.

(Document marked as requested by the Notary Public.)

Q. (By Mr. Freeman): Now, Mr. Masters, with the letter in front of you which has just been initialed

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)
by the reporter I am going to call your attention to the paragraph that I quoted in full a few minutes ago, and then I ask you what you meant by "dependent upon a single source or sources controlled by a single producer of tube fittings," and I ask you whether [25] you again refuse to answer?

Mr. Beehler: I again object on the ground that it is immaterial; that the document speaks for itself, if admitted, and that it calls for a conclusion of the witness and not a fact, and I direct him not to answer.

Q. (By Mr. Freeman): Well, will you tell me what you meant by the phrase in the letter "We are being supported financially and otherwise in this defense by a number of fitting manufacturers," and I am particularly interested in the terms "otherwise."

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): Do you likewise, Mr. Masters, refuse to answer, now that you have the letter in front of you which has been initialed by the reporter, and which you have identified as being sent out by your company under your direction?

A. By direction of counsel I am refusing.

Q. I am going to ask you what you meant in this letter when you said "It is, of course, legitimate for you to keep your costs down by buying such material, but how long do you think the prices will stay down after the independent producers of fittings have been eliminated"?

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): And I take it when you refer to "independent producers of fittings" in your letter of January 19, 1948, you were referring to those outside of [26] the Parker Company licensees; correct?

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): Do you likewise refuse to answer? A. I do.

Q. I am going to ask you, Mr. Masters, did you send any other letters subsequent to January 19, 1948, to the trade with respect to Parker Company's patents?

Mr. Beehler: I object to that on the ground it is immaterial to the issue, and I direct the witness not to answer.

Q. (By Mr. Freeman): Do you likewise refuse to answer, Mr. Masters? A. I refuse.

Q. And do you refuse on the instructions of your attorney? A. That's correct.

Q. Did you send any letter to Republic Aviation Corporation, attention its purchasing agent, with respect to the pending litigation?

Mr. Beehler: I object to that on the same grounds and make the same direction.

Q. (By Mr. Freeman): I am going to ask you again, Mr. Masters, if it is not a fact that on April 27, 1949, you, on the letterhead of the Masters Company, that is, Irvin W. Masters, Inc., and signed

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

by yourself as president of that company, addressed a letter to Mr. Larry Cunningham, [27] Purchasing Agent, Republic Aviation Corporation, Farmingdale, Long Island, New York, all with respect to the infringement suit here pending?

Mr. Beehler: Go ahead.

The Witness: I did.

Q. (Mr. Freeman): Again I am going to ask you what you meant in this letter where you said "If such is the case, we believe it to the best interests of the Republic Aviation Corporation and the entire aviation industry, to give consideration to the fact that anything wihch contributes to the re-establishment of the Parker fitting monopoly will contribute to the old situation of long delays in the procurement of fittings, and where high prices in general existed"?

Mr. Beehler: I am going to object on the ground the document, if admitted, speaks for itself.

Q. (Mr. Freeman): Now, Mr. Masters, will you answer my preceding question?

A. As directed by my counsel I will decline to answer on that.

Q. I did not understand your counsel to advise you not to answer. He merely objected to the letter as speaking for itself.

Mr. Beehler: I direct him not to answer.

Q. (By Mr. Freeman): What was the occasion of writing the letter of April 27, 1949, and for your convenience I am going [28] to give you a copy of it to refresh your memory.

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

Mr. Beehler: I again object on the ground of immateriality, and I direct the witness not to answer.

Q. (By Mr. Freeman): I am going to ask you, Mr. Masters, if you refuse to answer my last question?

A. I do, as directed by counsel.

Q. Will you produce the carbon copy of the letter of April 27, 1949, which is addressed to Republic Aviation Corporation?

Mr. Beehler: I object to the production unless ordered to do so by the court.

Q. (By Mr. Freeman): You do recall definitely sending such a letter to Mr. Larry Cunningham, Purchasing Agent, Republic Aviation Corporation, under the date of April 27, 1949, do you not?

A. Yes.

Q. Now, what was the occasion of writing that letter?

Mr. Beehler: Same objection and same instruction as before.

Q. (By Mr. Freeman): It is a fact that at the time you wrote the letter on April 27, 1949, there was then pending a scheduled date for the taking of depositions on the part of Parker Appliance Company in New York City?

A. That is right.

Q. And likewise at that time you knew that the depositions to be taken were of witnesses who were

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

employed [29] by and under the control of Republic Aviation Corporation? A. Shall I answer?

Mr. Beehler: Yes, go ahead.

The Witness: Yes, that is right.

Q. (By Mr. Freeman): I am going to ask you what you meant when you said in your letter "We assume that these depositions being taken at the instance of The Parker Appliance Company are calculated to be beneficial to the case of The Parker Appliance Company"?

Mr. Beehler: I object to that on the ground the letter speaks for itself and the question calls for a conclusion of the witness, and direct him not to answer.

Q. (By Mr. Freeman): Do you refuse to answer, Mr. Masters? A. I do.

Q. What did you mean by "beneficial to the case of The Parker Appliance Company"?

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): And likewise you refuse to answer? A. Yes.

Q. And I take it that when you said "beneficial" or used the term "beneficial" you meant that to be synonymous to help The Parker Appliance Company?

Mr. Beehler: Same objection and same direction.

Q. (By Mr. Freeman): And you likewise refuse to answer? A. Yes.

Q. You do have the copy of the letter that you

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)
sent [30] to Republic Aviation Corporation under date of April 27, 1949, in your company's file?

A. I think so.

Q. You refuse to produce it unless ordered by the court so to do; correct?

A. As directed by counsel, yes.

Q. When you say "directed by counsel" you mean counsel here present as of today?

A. Yes, sir.

Mr. Freeman: I offer in evidence, in behalf of The Parker Appliance Company, a copy of the Irvin W. Masters, Inc., letter of April 27, 1949, to Republic Aviation Corporation as Plaintiff's Exhibit 10.

(Letter referred to was marked by the Notary Public as Plaintiff's Exhibit 10, and thereupon returned to counsel.)

Mr. Beehler: I make my objection here to the presentation of the letter as an exhibit on the grounds that it is irrelevant and immaterial.

Q. (By Mr. Freeman): Mr. Masters, is it true that in addition to the letters that you have written of the kind referred to here, dated January 19, 1948, and April 27, 1949, that you asked a publication house to publish a paid advertisement with respect to the Parker patent?

A. May I answer on that?

Mr. Beehler: Yes. [31]

The Witness: Without referring to the edition

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

too, it is true that I sought to have published in Aero Digest a letter stating our situation, which they declined to do, because Parker Appliance Company spent more money with them than we did.

Mr. Freeman: I move that the last part of that answer "because Parker Appliance Company spent more money," and so forth, be stricken as not responsive.

Q. Do you have a copy of the proposed advertisement in Aero Digest in your files?

A. I presume we do, Mr. Freeman.

Q. Will you produce it?

Mr. Beehler: I object to the production of it unless ordered to do so by the court, on the ground that it is immaterial.

Q. (By Mr. Freeman): Did you have any correspondence with Aero Digest wherein they refused to publish the ad?

A. No, I don't believe I did. I think that that information was reported to me very adroitly by their local representative verbally.

Q. Now, just tell us what the information was that was conveyed to you by the local representative of Aero Digest?

A. Well, when I presented the letter for publication in the first place I told Mr. Galloway I didn't believe his company would publish it, it was so controversial, and he [32] urged me to present it, as Tichenor, the publisher and editor of Aero Digest, was noted for going to bat on such things.

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)
When Mr. Galloway reported that they could not accept the advertisement he stated that Aero Digest had gotten down to a pretty thin size, and Tichenor's bread and butter was pretty much in jeopardy, and got his ears beaten back a good many times, and he thought it was indiscreet to publish it, notwithstanding his sympathies.

Q. Will you give us Mr. Galloway's full name and address, if you can?

A. I don't know Mr. Galloway's address. He has an office here in Los Angeles. If I might look at a telephone book I could identify it. (Telephone book handed to the witness.) "James C. Galloway, Publisher's Representative, 816 West Fifth Street, Los Angeles."

Q. Mr. Masters, you do manufacture your sleeves of the fittings that you have here produced so that there is a taper on the outside wall of each sleeve?

A. Well, we have manufactured those sleeves, when we did manufacture them, in accordance with the Army and Navy Standards, and those Standards did specify a taper on the head of the sleeve you are talking about.

Q. When you talk about the head of the sleeve, that is the nose end or the end that engages the base of the flare; correct?

A. Well, you said the outside. Where it engages the [33] base of the flare is on the inside of the sleeve.

Q. I am asking whether it isn't a fact that the

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

portion of the sleeve which engages the flare close to the base of the flare is in fact of less diameter than the remainder of the portion of the sleeve? Do you follow my description?

A. It engages on the inside of the sleeve. Your question is confusing to me, Mr. Freeman. You said "taper on the outside of the sleeve," and then you ask where it engages the flare. The engagement between the sleeve and flare is, I believe, on the inside of the sleeve.

Q. I was just referring to what I might call the nose end of the sleeve. In other words, the diameter of the sleeve at the point which engages the flare of the tube is of less diameter than the portion of the sleeve which engages the nut shoulder?

A. If I understand you correctly, it is true that since the early part of the war, I don't know, I believe possibly 1942 or along thereabouts, the AN drawings were made to show, and also the 811 drawings were made to show a slight tapering on the outside of the large diameter of the sleeve. The diameter at the end closest to the—the outside diameter of the end closest to the flare was slightly less by reason of a one degree taper, I believe, in the sleeve. [34]

Q. And when your company manufactures sleeves you do provide that taper on the outside surface of the sleeve? A. That is right.

Q. And I take it also that your company manufactures sleeves with a double angle on the outside

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

of the sleeve which engages the outside of the flare?

A. Where such a double internal angle is specified in the drawings we do, yes.

Q. Now, the first form of sleeve that I asked you about is substantially as illustrated in Plaintiff's Exhibit No. 2; correct?

A. Yes, that is right.

Q. Then the second form, where I asked you about a double angle on the inside of the sleeve, or the nose end of the sleeve which engages the flare, it is substantially as illustrated in Plaintiff's Exhibit 8; correct? A. That's right.

Q. You manufacture sleeves of both kinds, that is, as exemplified by Plaintiff's Exhibit 2 as well as Plaintiff's Exhibit No. 8?

A. That's right.

Q. Did I understand you to say that you followed the AN or the 811 drawings with respect to angles and measurements in the manufacture of sleeves?

A. That is right, we follow both of them, according to the procurement specifications. [35]

Q. I said "sleeves," and that, of course, goes for nuts and bodies?

A. That is right, we always manufactured them according to the Government drawings.

Q. Did you do any independent research or engineering with respect to the various angles or dimensions used on the AN fittings or the 811 fittings?

Plaintiff's Exhibit No. 12—(Continued)

(Deposition of Irvin W. Masters.)

A. Will you define what you mean by "independent"?

Q. Well, did you arrange for the outside angle on the sleeve, did you do that, or did you merely manufacture that which was illustrated in the drawings, which engineering was done by someone else?

A. No, I never discovered it until this trial came up.

Q. You did follow the drawings, though?

A. Sure, that's right.

Q. And you now know that you have manufactured and are manufacturing sleeves with an angle on the outside of the sleeve?

A. That is right.

Q. And you now know that you have manufactured and are manufacturing sleeves with double angles on the inside?

A. Well, I knew that from the outset of the changes that were instituted at Douglas.

Q. And you followed along with those changes?

A. That is right. [36]

Q. You did not independently do any engineering with respect to the double angle, did you?

A. No.

Q. Did you maintain an engineering department, including draftsmen, design engineers?

A. Yes.

Q. But in connection with the three piece fittings of the kind we have here you merely made those to the measurements and specifications of the AN and 811 drawings?

Plaintiff's Exhibit No. 12—(Continued)
(Deposition of Irvin W. Masters.)

A. Except where we occasionally found discrepancies which we reported to the appropriate Government agencies that took them under consideration and——

Q. However, with respect to the outside angle on the sleeve you merely followed the drawing specifications? A. That is right.

(A short recess was here taken.)

Q. (By Mr. Freeman): These drawings that you have handed me in duplicate, marked "Active," those are the drawings from which you have manufactured and now manufacture fittings, sleeves and bodies? A. That is right.

Q. Nuts, bodies and sleeves, collectively referred to as fittings? A. That is right.

Mr. Freeman: Just for convenience I am going to ask the reporter to initial and date each of the drawings, at [37] least one set.

(Documents were marked as directed by the Notary Public.)

Mr. Freeman: That will be all.

Mr. Beehler: No cross-examination.

Mr. Freeman: With respect to the witness waiving signature, will you waive your signature, Mr. Masters?

Mr. Beehler: Yes, we can do that.

Mr. Freeman: I want to make it appear that Mr. Masters waives his signature.

The Witness: O. K. [38]

Plaintiff's Exhibit No. 12—(Continued)

State of California,
County of Los Angeles—ss.

I, W. E. McClure, a Notary Public within and for the County of Los Angeles and State of California, do hereby certify:

That prior to being examined the witness named in the foregoing deposition, Irvin W. Masters, was by me duly affirmed to testify the truth, the whole truth, and nothing but the truth; that the said deposition was taken down by me in shorthand at the time and place therein named, and thereafter reduced to typewriting under my direction.

I further certify that it was stipulated by and between counsel that the signature of the witness to the said deposition be waived, and that it shall possess the same force and effect as though read and signed by the said witness.

I further certify that I am not interested in the event of the action.

Witness my hand and seal this 17th day of July, 1949.

[Seal] /s/ W. E. McCLURE,
Notary Public in and for the County of Los Angeles, State of California.

Received in evidence June 14, 1950.

PLAINTIFF'S EXHIBIT No. 13

In the District Court of the United States, Southern District of California, Central Division

Civil Action No. 8023-W

THE PARKER APPLIANCE COMPANY,
Plaintiff,

vs.

JOSEPH C. COLLINS, Doing Business Under Firm Name and Style of Collins Engineering Co., Hollywood, California,
Defendant.

NOTICE OF TAKING DEPOSITIONS

To: Vernon D. Beehler, counsel for Defendant, Joseph C. Collins

Please Take Notice that the Plaintiff, The Parker Appliance Company, by its attorneys, Bair & Freeman, will take the deposition of the party Defendant, Joseph C. Collins or his agent. The deposition will take place at 10:30 a.m. on July 12, 1949, at the offices of Lyon & Lyon, 811 West Seventh Street, Los Angeles 14, California, before an officer duly authorized by law to take depositions.

Plaintiff's Exhibit No. 13—(Continued)

You may attend and cross-examine if you see fit to do so.

LYON & LYON,
/s/ CHARLES G. LYON,
Attorneys for Plaintiff.

Of Counsel:

/s/ WILL FREEMAN,

/s/ W. M. VAN SCIVER,

June 28, 1949.

Proof of service attached.

[Title of District Court and Cause.]

Civil Action No. 8023-W

Deposition of Joseph C. Collins, taken on behalf of plaintiff, at Suite 800, 811 West 7th Street, at the offices of Lyon & Lyon, Los Angeles, California, at 10:30 o'clock a.m., July 12, 1949, before W. E. McClure, a Notary Public within and for the County of Los Angeles and State of California, pursuant to the annexed notice of taking depositions.

Appearances of Counsel:

LYON & LYON, ESQS.,
CHARLES G. LYON, ESQ.,

BAIR & FREEMAN, ESQ.,
WILL FREEMAN, ESQ.,
For plaintiff.

VERNON D. BEEHLER, ESQ.,
For defendant.

Plaintiff's Exhibit No. 13—(Continued)

JOSEPH C. COLLINS

having been duly affirmed, testified as follows:

Direct Examination

By Mr. Freeman:

Q. You are Joseph C. Collins? A. I am.

Q. And the proprietor of the Collins Engineering Company, the defendant in this case?

A. Yes, I am.

Q. That is a sole business, that is, you own and operate the business in its entirety?

A. Right.

Q. What is the business of the Collins Engineering Company? A. We supply aircraft parts.

Q. Do you manufacture aircraft parts?

A. No, we don't manufacture them.

Q. You sell aircraft parts?

A. We sell aircraft parts.

Q. And by "aircraft parts" I assume we can refer to those parts as fittings?

A. They are one of the items that we sell.

Q. Those are three-piece fittings?

A. No, they are just individual fittings. [2*]

Q. But you do sell nuts, bodies and sleeves that make up three-part fittings?

A. Yes, we sell them individually.

Q. Now, when was the Collins Engineering Company organized?

A. Approximately February of 1941.

*** Page numbering appearing at top of page of original Reporter's Transcript of Record.**

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. When did you start the sale of fittings?

A. I believe it was about a year later.

Q. You are familiar with the fittings generally known as the Parker type fittings?

A. Yes, I am.

Q. When did you commence the manufacture of such fittings?

A. Approximately about—if my memory serves me right, about a year after we formed our company, and that was about, around February of 1942, I think.

Q. A moment ago you said that you sold fittings as distinguished from manufactured, as distinguished from the manufacturing of fittings. It is true that when you started in the fitting business in 1942 you then manufactured your own fittings?

A. Yes, that is correct.

Q. And you continued manufacturing fittings up until about the close of the war?

A. Up until about the close of the German phase of the war. That was about 1944. [3]

Q. Thereafter you disposed of your equipment, that is, screw machines and machines of that kind for the manufacture of fittings, and had your fittings manufactured for you?

A. That is correct.

Q. It is true that you use a good many shops throughout the Los Angeles area for the manufacture of the component parts that make up fittings?

A. That is correct.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Now, in the fittings that you manufactured in 1943 and 1944 in your own plant, they, in fact, do not differ from those that you are now selling?

A. Fundamentally not. There is some print changes but——

Q. So that the difference in the Collins Engineering setup, which difference took place, as you say, along the year 1944, was one of manufacture and sale of the fittings prior to 1944, and sale of the fittings after 1944? A. That is correct.

Q. And when I use the year 1944 I am just picking that out as sort of a dividing line. We are not setting forth any specific date.

Mr. Collins, did you bring with you the blueprints and drawings or photostats of drawings which were requested by way of a motion filed in the Federal Court here some week or so ago? [4]

A. I brought with me as much as I could obtain. We make our fittings from the AN Standards, the various prints that come out of Wright Field, and I had duplicated on our duplication machine the AN Standards of the sizes and the nomenclatures of the fittings that you requested. I believe we have them all.

(A discussion was had off the record.)

Q. (By Mr. Freeman): Now, Mr. Collins, will you just produce whatever drawings you have been able to locate up to the present time, and I understand that you have been unable to locate some of the drawings; that is correct, is it not?

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

A. No, we have brought in all of the drawings we possibly can. These are the only obtainable drawings from our records at the present time, because these are the drawings that we now use to check our fittings, but—in other words, under the particular paperwork we received, this motion for producing of the documents there, it called for, I believe, all of the various deviations that these fittings have gone through throughout the years of 1940 to 1949. Well, when we get a new print from Wright Field all old prints are automatically destroyed by our inspectors, due to the fact we do not want an old or obsolete print around any more, because they might thereby receive into the plant an obsolete fitting. So we brought in all the up-to-date AN Standards, but I would have to try to write to Wright Field and ask them if they could give me all the old prints. [5] For instance, the 819 series that you requested has been revised once, twice—has been revised nine times. I can't give you the nine revision papers from Wright Field on this part, because I don't have them.

Q. So that we might straighten it out, and I only want that which you have: In 1942 and 1943, when you were doing your own manufacturing, did you have manufacturing drawings or shop drawings?

A. I had the AN prints.

Q. As furnished to you by Wright Field?

A. Yes.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Did you ever have any drawings furnished to you by The Parker Appliance Company?

A. Not to my knowledge.

Q. In your own shop manufacture I understand that you used only the drawings which were furnished to you by Wright Field, or AN drawings?

A. Yes, or possibly the airframe manufacturer might have sent me a print of a certain part, and I manufactured it according to their print.

Q. I understand then that you do not have any of the drawings that were used in 1942 and 1943 unless the drawings that you have here were likewise then used?

A. That is my best knowledge and belief, yes.

Q. Now, so far as your own files are concerned, and I am not asking you to go out and shop for drawings in other [6] plants, but so far as your own files are concerned you have here produced all of the drawings you have available?

A. That is correct.

Q. And as called for by the motion?

A. Correct, any drawings that I might have at my plant would only be a duplicate of these drawings here.

Mr. Freeman: Now, if I may have the sets that you have prepared, I will appreciate it.

Mr. Beehler: Off the record.

(A discussion was had off the record.)

Q. (By Mr. Freeman): Mr. Collins, are you telling us now that the drawings that you have here

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

handed me are the shop drawings that were used for manufacture?

A. Yes, those are duplicates of the shop drawings that we would duplicate and hand to a machinist during the years which we were manufacturing fittings.

Q. In other words, while you operated your own plant the drawings that you have here handed me were the kind that you used, and used as shop manufacturing drawings?

A. Yes. Anything that we would have would be an exact duplicate of this drawing here.

Q. Now, I recognize that what you have handed me may be used for inspection of parts and not for the manufacture of parts. However, your testimony is that these are the only drawings that you used and that they were used as shop manufacturing drawings? [7]

A. That is correct. Any shop drawing that we have in addition to these would be the information that was taken directly off of this sheet and duplicated and placed on another sheet, but it would be identical with this sheet here.

Q. Did you have your own drafting department?

A. During the war, yes.

Q. Now, when you want an 819 sleeve made do you furnish a print of the kind that is here shown marked "AN819" to the screw machine shop?

A. Not as a rule, no. Generally he knows the part and he has his own prints.

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

Q. You inspect the parts that come to your plant? A. Yes, we do.

Q. What do you use by way of inspection drawings?

A. We use these drawings here, the AN Standards.

Q. And your inspection is always done against the so-called Government AN drawings?

A. Yes, the latest spec.

Mr. Freeman: So that the record is complete, you have handed me drawings No. AN819, drawings No. AN804, drawings No. AN-D 10056, drawings No. AN816, Drawings No. AN818, and I am going to ask the reporter to put his initials and the date on the back of one set of the drawings.

(Documents were marked as requested by the Notary Public.) [8]

Q. (By Mr. Freeman): Now, these sheets you have handed me are what are sometimes called dimension sheets?

A. Yes, I believe they would be called dimension sheets. I have never heard that name before, but that is what no doubt they are.

Q. Are you an engineer, Mr. Collins?

A. No, I am not.

Q. You are a member of the Bar?

A. I am a member of the Bar.

Q. Of the California Bar?

A. California Bar.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Have you at any time practiced law?

A. No, not actively.

Q. Although you are a member in good standing at the present time? A. In good standing.

Q. Now, the motion also requested that you produce any literature or catalogs used by your company from the years 1940 on to date, and you having started in 1942 I would like to have any catalogs that you have for the period of your operations.

A. We researched, and here is our prior catalog and this is our most recent catalog.

Mr. Freeman: Now, the one that you have referred to as your "prior catalog" I am going to ask the reporter to mark for identification as Plaintiff's Exhibit 11. [9]

(Document referred to was marked by the Notary Public as Plaintiff's Exhibit 11 for identification, and thereupon returned to counsel.)

Mr. Freeman: And the one that you have referred to as the "more recent"——

The Witness: Yes, that is it.

Mr. Freeman: ——I am going to ask the reporter to mark it as Plaintiff's Exhibit 12 for identification. It is understood, Mr. Beehler, we can offer these later without any further proof?

Mr. Beehler: That is right.

(Document referred to was marked by the Notary Public as Plaintiff's Exhibit 12 for

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

identification, and thereupon returned to counsel.)

Q. (By Mr. Freeman): Now, Mr. Collins, you referred to your earlier catalog which has been marked for identification as Plaintiff's Exhibit 11. Can you tell me about when that was published?

A. I would say about—I believe about a year to 18 months ago.

Q. In other words, along in 1947?

A. I think it would be more in '48.

Q. How about Plaintiff's Exhibit 12 for identification, when was it published? [10]

A. It was published about three months ago.

Q. Do I understand then that you have no catalogs of any kind, or literature with respect to AN fittings, tube couplings of the kind here involved for the years 1942 up until about 1948?

A. We searched for any such catalogs and we could not find any.

Q. In other words, you have no file copies, no vault copies, nor any copies of catalogs put out prior to 1948?

A. Well, this one is such a copy, but——

Q. By "this one" you are referring to Plaintiff's Exhibit 11 for identification; correct?

A. Correct, but beyond that we could find none.

Q. Did you put out any circulars with respect to AN fittings prior to the catalog Plaintiff's Exhibit 11?

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

A. No, I don't believe we have ever put out any circulars.

Q. In other words, you have here produced all the literature you have in your files with respect to catalogs, circulars or publications having to do with AN fittings, and the answer is you have found none until about 1948? A. That is correct.

Q. You did, however, have some catalog publications in 1947, 1946 and 1945, did you not?

A. Yes, we had. I recall one before this one here.

Q. And "before this one here," you are referring to [11] Plaintiff's Exhibit 11?

A. Before Exhibit 11 we had one, and I don't think we had any prior to that time, any catalog. The one before this was our first catolog.

Q. You started into the manufacture of fittings because of the war, did you not?

A. Yes, I would say yes.

Q. And you continued substantially your own manufacturing operations until about the close of the war?

A. Until about the close of the German phase of the war.

Q. Can you give me the names of some of your present suppliers of fittings?

A. Pacific Screw; Deutch—how many did you want, Mr. Freeman?

Q. Oh, I would like some of the others. You know there are quite a few of them.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

A. There is one company by the name of Durite; Bird——

Q. That Durite is Durite Manufacturing Company of Santa Monica, California?

A. Yes, and Bird, I think he calls himself Bird Aircraft.

Q. Where is he located?

A. He is out in the Valley.

Q. San Fernando? A. Yes. Glendale. [12]

Q. You likewise buy from the Elmore Engineering Company? A. Yes, we do.

Q. They are located at Alhambra?

A. Alhambra.

Q. Do you buy from the Airdrome Products, Inglewood, California? A. Yes, we do.

Q. Do you buy from the Indus Manufacturing Company?

A. No, I don't think—I know we don't buy from them.

Q. Do you buy from the Parus Manufacturing Company? A. No, we don't buy from them.

Q. Inglewood, California? A. No.

Q. Might that be the Parts Manufacturing Company? A. Oh, yes, P-a-r-k-s, Parks.

Q. At Inglewood, California?

A. Yes, it is very close, he is in there somewhere.

Q. In the Los Angeles area?

A. Yes, in the Los Angeles area.

Q. Do you likewise purchase from Carruthers & Fernandez?

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

A. Yes, we do; very, very little, but we have purchased from them.

Q. Do you ever buy from a Victor Pastushin Industries?

A. No, I know him, but we don't buy any fittings from [13] him.

Q. Have you bought any fittings from Al Lamatrice at Wilmar, California?

A. Yes, we have.

Q. Now, are there any others?

A. You have covered them pretty well. I don't for the moment, recall any more. I personally don't handle that particular phase of our company, so——

Q. Who is your agent or representative, or the man in charge for the purchase of fittings?

A. That is Glenn Stillwell, he is the one.

Q. That is S-t-i-l-l-w-e-l-l? A. Right.

Q. And is he your authorized agent and representative? A. Yes.

Q. And he speaks for you in connection with the purchase of fittings? A. Yes.

Q. Now, the fittings that you purchased from the Durite Manufacturing Company, it is true that you buy from them the nuts, sleeves and the bodies?

A. Well, I don't know what we buy from Durite. I don't know what particular fittings that he manufactures. I know we buy fittings from him, but just which ones I would have to look up purchase orders to find that out. [14]

Q. Is that likewise true with respect to these

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

other names that you have mentioned, those suppliers of you, that you buy nuts, bodies and sleeves from them?

A. Yes, it is. Certain ones manufacture certain fittings to a better ability than other type of fittings, so that they become specialists in certain types, so——

Q. You then sell the complete unit, the three component parts to the aircraft manufacturers?

A. No, we don't. We sell the individual fitting to whoever will buy it. We sell no assemblies whatsoever.

Q. But you do sell in the same order nuts, sleeves and bodies?

A. Not necessarily at all. We might just sell one sleeve or a thousand sleeves. We might sell one nut by the same purchase order.

Q. Are you telling me you have never sold nuts, sleeves and bodies in the single order or in the single billing?

A. That is correct, never—we have never sold an assembly in the history of our company.

Q. You have sold nuts, sleeves and bodies to aircraft manufacturers for complete use, have you not?

A. What they do with them, Mr. Freeman, after we sell them the component parts I don't know.

Q. You do sell the component parts that go to make up the complete fitting? [15]

A. Yes, we do.

Q. And you sell them to the same purchaser?

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

A. At times we do.

Q. Now, do you know the name of the individual that you have had your business dealings with at Durite? A. His name is Irv.

Q. Withekan, W-i-t-h-e-k-a-n?

A. I don't know what his name is. Irv. I-r-v, I know him by that. He is sales—I don't know what his last name is.

Q. Do you know a Mr. Curtis there?

A. Curtis?

Q. Yes. A. At Durite?

Q. Yes.

A. I frankly do not know him personally. No, I don't know if he works there or not.

Q. Do you know a Mr. Russell there?

A. No, I don't know him.

Q. Now, when you want to have that company, and let's take Durite by way of example, manufacture nuts, bodies and sleeves for you what do you furnish that company?

A. Well, we—it is according to whether—if it is a straight part invariably they supply us the complete part. We supply them nothing.

Q. Well, do you supply them with [16] drawings? A. No.

Q. In other words, you just issue a purchase order? A. We issue a purchase order.

Q. And you say you want part No., by way of example, AN818? A. Right.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Do you furnish them with inspection drawings or shop drawings?

A. No, they supply us the parts and we inspect the parts when they come there.

Q. All you put down is the size?

A. The size and the material that we want them made from.

Q. Do you give certificates to your purchasers as to the material that goes into the various fittings?

A. In some instances we do.

Q. Now, do you make an inspection of that, or do you receive a certificate from your supplier or your manufacturer as to the material that go into the fittings?

A. When we buy any steel or have any forgings made we get a proper certification from our supplier.

Q. Well, now, when you say "forgings" or "steel," do I understand that you buy the forgings and the steel and then have one of these shops manufacture the sleeves, nut and bodies from such forgings and from such steel, or do they buy their own steel and make their own forgings? [17]

A. Well, on the—Mr. Freeman, always adding "nuts, sleeves and bodies" you complicate the explanation. If they are making a body for me I, as a rule—that is, a shape, what they call a shape—I supply as a rule the forging itself, but if it is a nut or sleeve, in most instances they supply their

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)
own material, because they can buy it as well as I can.

Q. Then do you get from these manufacturers certificates as to the material used?

A. In some instances we do.

Q. Well, it is a fact that you are requested to give certificates to your purchasers certifying as to the material used in the nuts, sleeves and bodies?

A. Only in some instances.

Q. Do you give certificates as to the chemical and physical analyses of the fittings that you sell?

A. When it is requested or demanded, yes.

Q. Do you get from your manufacturers certificates with respect to the chemical and physical analyses?

A. When we need it or when it is demanded, yes, we do.

Q. And if you get chemical and physical analyses you get them at the time that the fittings are delivered or furnished to you by the manufacturer?

A. Right.

Q. Then do you make your own chemical and physical [18] analyses, or do you rely on the manufacturers, the screw machine manufacturers that make the various parts for you?

A. Both. We rely on them, and if we have any doubt in our mind we send it up to Mare Island, or send it out to Triplett & Barton and have them make an analysis.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Now, my motion requested the production of certain physical units. Do you have some of them here? A. Yes, we have.

Mr. Freeman: Off the record.

(A discussion was had off the record.)

Q. (By Mr. Freeman): Would you mind giving me the units that you have produced in sets, identifying any set, and you can use your own choice as to the manner of production, and then if I can get a string we will fasten them together so that they will always remain the same.

A. We haven't produced any in sets, Mr. Freeman. I produced this part——

Q. By "this part" you are talking about a body?

A. A body. I had this body produced or machined—use the word "machined."

Q. Do you have a nut and a sleeve to go with that body?

A. No, I don't. Yes, I do. This is an accompanying nut and accompanying——

Q. Will you give the material of which that sleeve is made? I note that the fitting you have there—the nut and [19] the body is made of steel.

A. I want to add for the record on the thing that I may not have produced all these parts. We deal very extensively in surplus, but whether I brought down accompanying parts—for instance, this (indicating). Some of these parts we may not have

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

had produced or not made, but we might have bought them at surplus and imprinted AN-CE on there, an impression stamp.

Q. When you put on "AN-CE" does that then mean it was manufactured by Collins Engineering Company?

A. No, it means that we supplied it to the air-frame manufacturer, not necessarily that we machined it or produced it. It is a supplier's stamp.

Mr. Freeman: You hand me, if you will, the body, sleeve and nut that you have assembled, and I am going to ask that a string be put through those three parts and marked for identification as Plaintiff's Exhibit 13.

The Witness: Mr. Freeman, do you want me to put them together? I can put them together.

Mr. Freeman: We will put them together. We just want the three pieces.

The Witness: I will hand them to you three at a time, those three.

(Objects referred to were marked by the Notary Public as Plaintiff's Exhibit 13 for identification, and thereupon [20] returned to counsel.)

Q. (By Mr. Freeman): The fittings that you sell include the marking of your company, such as "CE"; correct? A. Correct.

Q. And the three parts that you have given me

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)
which are marked Plaintiff's Exhibit 13 for identification include such markings? A. Correct.

Q. Now, do you have other sets of fittings?

(Object handed to Mr. Freeman.)

Do you have a sleeve and nut for the body that you have here handed me, which is a size 4 fitting?

A. Yes, I have a sleeve and a nut here.

Q. You have a sleeve and nut of the same material? A. No, I don't. I have one of steel.

Q. Are they usually used, an aluminum body with a steel sleeve and a steel nut?

A. I don't know, Mr. Freeman. I am no engineer. I just make these component parts and they assemble them any way they want.

Q. You do make these component parts so that they interfit and interconnect, do you not?

A. Correct.

Q. So that they will make a proper joint?

A. Yes. If they are made to the print, to the AN print, they should mate perfectly. [21]

Mr. Freeman: I am going to ask that the parts that you have handed me, which is size 4, and which bears the initial "CE" thereon, be marked for identification as Plaintiff's Exhibit 14.

(Objects referred to were marked by the Notary Public as Plaintiff's Exhibit 14 for identification, and thereupon returned to counsel.)

Q. (By Mr. Freeman): Now, each of the parts

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

that go to make up Exhibit 14 bear the initial "CE" thereon, and are of your manufacture, that is, you are responsible for their manufacture?

A. Yes. I don't know if we had those produced or if we were responsible for the manufacturing, inasmuch as we buy so much surplus. Those could be surplus parts and overstamped or an impression stamped by ourselves.

Q. I am going to ask you to take and examine Plaintiff's Exhibit 14 carefully, and tell me whether or not they are overstamped or whether they are originally stamped and are of your manufacture or your responsibility for their manufacture.

A. The nut is a part that we had run, and a sleeve is never stamped, at least, this one isn't stamped, so on the sleeve I would say that is not our manufacture, but is a surplus purchase; and on the body I can't tell you on this whether it is ours or whether we bought it in surplus. [22] It has our name "CE" stamped on it.

Q. Would you say that was an overstamp or was that initially stamped?

A. No, it looks like initially stamped to me.

Q. And anodized after the stamp was put on?

A. Yes.

Q. You don't re-anodize any surplus parts, do you?

A. Yes, we do, a tremendous amount of them.

Q. Now, will you give me another set or two?

(Objects handed to Mr. Freeman.)

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

What you have handed me is a size 4 in steel; correct? A. Right, correct.

Mr. Freeman: I am going to ask that the reporter mark the fittings just handed me as Plaintiff's Exhibit 15 for identification.

(Objects referred to were marked by the Notary Public as Plaintiff's Exhibit 15 for identification, and thereupon returned to counsel.)

Q. (By Mr. Freeman): Do you still have some additional parts that are not duplicates of parts that you have already handed me?

A. No, I think you have a complete set of everything, except this, an individual part.

Q. Was that asked for by our motion? [23]

A. I don't think so.

Mr. Freeman: Then I am not interested in it. I am wondering if you would now hand me the duplicates of the three exhibits that have been referred to as Exhibits 13, 14 and 15?

(Objects handed to Mr. Freeman.)

Mr. Freeman: Off the record.

(A discussion was had off the record.)

Q. (By Mr. Freeman): You sell your fittings to anyone that wants to buy them and has the money to pay for them? A. Right.

Q. That has been your practice from the time you started in business? A. Right.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. And you have within the last six years actually manufactured or had manufactured for you nuts, sleeves and shapes or bodies?

A. Right.

Q. That is your practice as of today?

A. Right.

Q. And, as I say, the only difference, you had your own plant originally and now you use the facilities of others? A. That is correct.

Q. However, in the sale of your products back in 1942, 1943 and 1945 they were identified by the initial [24] "CE" and were of your own manufacture? A. Yes, that is correct.

Q. And as of today what you sell you again initial "CE," and are manufactured for you by others? A. Right.

Q. And the manufacture by others is done on your direction and instructions and under your supervision?

A. Well, not under our supervision. We place a purchase order with a reputable shop, and they supply us with parts. How they make them or what manner, we don't care as long as they deliver to us perfect fittings.

Q. By "perfect fittings" you mean those that meet your required specifications?

A. Correct, and our required specifications is the AN specifications.

Q. You do not have an engineering department

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)
of your own to determine the various angles that are put on the sleeves or the nuts or the bodies?

A. No, we don't have any engineer.

Q. In other words, you use only AN drawings?

A. Right.

Q. And your company had nothing to do with determining the angle of the inside of the sleeve or the angle on the outside of the sleeve?

A. No, we didn't. We were written to by—during the war, by that committee, I don't even remember the name, and [25] we would make some general answers, but that is about all.

Q. Did you ever furnish to the Production Resources Section, Materiel Center, Wright Field, your qualifications with respect to the manufacture of Parker type fittings?

A. That I don't know. We might have.

Q. Did you ever have any inquiry from that section of the Government at Wright Field with respect to your ability to manufacture Parker type fittings?

A. I think during the war they no doubt inquired of our ability.

Q. And no doubt you answered as to your ability to manufacture Parker type fittings?

A. I think such surveys were sent out, and I am quite sure we would answer them, as they were sent out.

Q. You said you started manufacturing fittings in 1942, and I would like to have you reflect for a

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

moment and tell me whether or not it wasn't until 1943 that you began manufacturing the fittings?

A. Well, it could have been, Mr. Freeman. We originally went into a valve operation, and then we were in it for quite some time, and then went into fittings a substantial time later after our company was formed, and it could have been 1943. I would have to personally look up our original invoices to determine the exact date.

Q. Would you mind rechecking, so that we can later get from you a definite date when you started the manufacture [26] of Parker type fittings?

A. Yes, I can check that up and give us the exact month and year, I believe, on that.

Q. You were one of the men that attended a meeting in January of 1948 at the Jonathan Club here in Los Angeles, in connection with litigation brought by Parker Appliance Company against Masters?

A. Yes, I attended one meeting down there. I don't know the exact date. What date did you say that was?

Q. Along in January of 1948.

A. Well, the exact date I don't know, but I attended one meeting down there.

Q. And that was prior to the time that you were sued? A. Yes, that is correct.

Q. Did you then agree to support Masters in his suit financially? A. Yes, I did.

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

Q. Did you actually make any contribution of money towards the defense of his suit?

A. Yes, I did.

Q. Did you send out any letters soliciting others as independent manufacturers to assist in the litigation against The Parker Appliance Company?

A. No, sir.

Q. Did you have any conference with any of the other so-called individual manufacturers of fittings with respect [27] to making contributions or supporting the Masters suit financially?

A. No, no, I did not.

Q. Your support was only in your own behalf?

A. Regretfully, yes.

Q. Did you ever buy any fittings from Mr. Masters or from the Masters Company?

A. Yes. It is rarely, but we do.

Q. On the catalog, Exhibit 12, you speak about "Our plant is equipped to fill your immediate requirements for bolts, nuts and so forth." You really mean you have the sales ability to fill——

A. That is correct. I forgot what advertising agency put that out, but it was sales enthusiasm, or their method of describing to our customers that we can supply them with their needs in fittings, because we don't have any plant or manufacturing ability.

Q. You have warehouse facilities?

A. Yes, we do.

Plaintiff's Exhibit No. 13—(Continued)

(Deposition of Joseph C. Collins.)

Q. And you do stock fittings, I mean the parts that go to make up the fittings?

A. Yes, we do.

Q. In other words, you don't wait until you have an order and then buy them from a manufacturer?

A. No, we actually stock in advance.

Q. And you carry a stock in size 4 and in size 8? [28] A. Yes, we do.

Q. And in the various metals, that is, steel, aluminum, and so forth? A. Correct.

Q. So that the only difference in your operation as of today or as of 1946 and 1947, distinguished from your operations in 1943, 1944 and 1945, is that prior to 1945 you did your own manufacturing and now you have others manufacture for you?

A. Yes, that is one essential difference. The other big difference is we are probably the largest purchaser of surplus fittings in the United States or the world, as far as that goes. We buy terrific tonnage of surplus fittings.

Q. I am primarily interested in your manufacture of fittings, and you have manufactured fittings all during these years from 1943 on up to the present time?

A. We manufactured up to the time we sold our machinery and now we buy the fittings from machine shops, who in turn manufacture.

Q. Perhaps I should say you manufactured or have manufactured for you fittings?

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

A. Correct.

Mr. Freeman: That is all, Mr. Beehler. [29]

Cross-Examination

By Mr. Beehler:

Q. There is only one thing that I would like to be sure is straight in the record. Mr. Collins, I call your attention to this Directory of Suppliers Aircraft Tubes and Fittings, prepared by Resources Control Section, April, 1944, in which are listed various manufacturers of different parts, for example, AC811BT nuts and AC811FT nipples. As of that period of time, 1944, you were then manufacturing those yourself, is that right?

A. Yes. I don't know when the exact cut-off date was, when we sold our machinery, but I believe it was the end of 1944.

Q. With regard to the drawings you may have used then what happened to them?

A. Like all other things coming out of the war, we more or less abandoned practically all of our wartime drawings and everything, and I guess they were lost in the movement of our plant. Our plant was converted over to an automobile agency, and I am afraid a lot of that stuff was destroyed at the time we cleaned out the plant in order to make an automobile agency out of the plant.

Mr. Beehler: That is all.

Mr. Freeman: I have a few more questions, Mr. Collins, I am sorry. [30]

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Redirect Examination

By Mr. Freeman:

Q. Mr. Collins, did you ever receive a threat of infringement from the Parker Company with respect to its patents Nos. 1893442 and 1977240?

A. Yes, I received a letter stating that they alleged that I was infringing on their patents. Just what patent numbers, I don't know, but I know I got a letter from Parker.

Q. My question was: did you ever receive a notice or a threat or any reference by The Parker Appliance Company to its 1893442 patent?

A. I am not familiar with the letter contents enough to know just what patents it enumerated.

Q. What customers of yours were threatened under Patent Nos. 1893442 or 1977240 by Parker Company, if you know?

A. Well, I don't know.

Q. As a matter of fact, you don't know whether Parker Company ever accused any of your customers with respect to the two patents last mentioned?

A. My memory isn't clear enough as to the numbers. I know they threatened North American and some of the other airframe manufacturers, and just under what particular numbers I could not state right now.

Q. Do you have any copies of any of those letters, or whatever you call threats? [31]

A. I have one, but——

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. Will you make it available to me?

A. If I still have it, I will.

Q. You don't know, though, definitely as of now that those letters included Patent Nos. 1893442 and 1977240, do you? A. No, I don't.

Q. You did receive a notice of infringement under the patent in suit No. 2212183 from The Parker Appliance Company, or its attorney?

A. Mr. Freeman, I received a letter, and unless I find that letter, if I have the letter yet, I would have to refresh my memory and read the actual numbers there enumerated. I know I received a letter from Parker alleging infringement. Just what the numbers were the letter itself would be the best evidence of that. I can't recall it from memory.

Q. Do you know on what basis your attorney included Paragraph XXVIII of the answer reading as follows: "That upon information and belief plaintiff by its agents, officers, employees and other persons responsible for its actions, has repeatedly and on many occasions openly accused defendant's customers throughout the trade of infringing certain patents, Nos. 1893442, 1977240 and 2212183, because of the use by said customers of couplings supplied by the defendant"? [32]

A. Merely from just hearsay and from general rumor and conversation. I have very many former Parker employees working for me, and it was their impression to myself that Parker was going to bring action against us and on all their patents.

Plaintiff's Exhibit No. 13—(Continued)
(Deposition of Joseph C. Collins.)

Q. In other words, you have former Parker employees? A. Yes.

Q. And at the time that they gave you that information they were then your agents, officers or employees? A. Yes.

Q. They were not Parker employees then?

A. No.

Q. I take it then, with respect to Paragraph XXVII, wherein you state that: "Upon information and belief plaintiff, by its agents, officers, employees and other persons" and so forth, that your same answer applies as you gave me with respect to Paragraph XXVIII?

A. Any—it was merely just general rumor that we received from the various buyers of the airframe manufacturers that Parker was going after us on all their patents, so I presumed that it would be all extant or existing patents, regardless of singling out one individual patent. I had, through various buyers of the airframe manufacturers, the conviction that Parker was going to go after us on every one of their patents that they held.

Q. After suit was filed against you by The Parker [34] Appliance Company you then knew that that suit was limited to Patent No. 2212183, did you not?

A. Well, yes, I had constructive notice of it.

Mr. Freeman: Off the record.

(A discussion was had off the record.)

Mr. Freeman: That is all.

Plaintiff's Exhibit No. 13—(Continued)

(A discussion was had off the record.)

The Witness: I am handing you, Mr. Freeman, two additional papers which I want to give you, one marked ANF-366 and the other marked "Air Force-Navy Aeronautical Standard Drawings, March 1, 1948."

Q. (By Mr. Freeman): Mr. Collins, are you agreeable to waiving your signature to this deposition?

Mr. Beehler: If you want to, you may.

The Witness: It is perfectly all right with me.

Mr. Freeman: That is all, thank you. Mr. Beehler, by agreement the exhibits introduced yesterday during the taking of the deposition of Mr. Masters and today of Mr. Collins may be retained by counsel for plaintiff, subject to inspection by defendant at all reasonable times, and that goes for the original deposition.

Mr. Beehler: Yes, that is satisfactory. [34]

State of California,
County of Los Angeles—ss.

I, W. E. McClure, a Notary Public within and for the County of Los Angeles and State of California, do hereby certify:

That prior to being examined the witness named in the foregoing deposition, Joseph C. Collins, was by me duly affirmed to testify the truth, the whole truth and nothing but the truth; that the said deposition was taken down by me in shorthand at the

Plaintiff's Exhibit No. 13—(Continued)

time and place therein named, and thereafter reduced to typewriting under my direction.

I further certify that it was stipulated by and between counsel that the signature of the witness to the said deposition be waived, and that it shall possess the same force and effect as though read and signed by the said witness.

I further certify that I am not interested in the event of the action.

Witness my hand and seal this 17th day of July, 1949.

/s/ W. E. McCLURE,

Notary Public in and for the County of Los Angeles, State of California.

Received in evidence July 14, 1950.

[Title of District Court and Cause.]

CERTIFICATE OF CLERK

I, Edmund L. Smith, Clerk of the United States District Court for the Southern District of California, do hereby certify that the foregoing pages numbered from 1 to 128, inclusive, contain the original Complaint for Infringement of Letters Patent, Answer and Counter-Claim and Reply in each of the above-entitled causes; Opinion; Findings of Fact and Conclusions of Law; Final Judgment; Notice of Appeal; Statement of Points; Plaintiff's Designation of Record; Defendants' Counter-Designation of

Record and Stipulation and Order Extending Time for Filing Counter-Designation of Record which, together with original depositions of W. Howard, Ehmann, William D. Clark, Edward M. Greet, Roland Bergh, Frederick E. Amon, Jr. and Robert Henry Davies in two volumes; Original Reporter's Transcript of Proceedings on June 14, 15, 16, 20, 21, 22, and 23 and July 5 and 6, 1950; Original Plaintiff's Exhibits 1 to 12, inclusive, 12-A, 13, 14, 15, 15-A, 16 to 28, inclusive, 28A to 28AA, inclusive, 28AA to 28 EE, inclusive, 29 to 62, inclusive, 62A, 63 to 73, inclusive, 73A, 73B, 74 to 80, inclusive; and Original Defendants' Exhibits A to H, inclusive, H-1 to H-5, inclusive, I to Z, inclusive, AA to TT, inclusive, TT-1 to TT-16, inclusive, UU to ZZ, inclusive, AAA to OOO, inclusive, transmitted herewith, constitute the record on appeal in the above-entitled causes to the United States Court of Appeals for the Ninth Circuit.

I further certify that my fees for preparing and certifying the foregoing record amount to $2.00 which sum has been paid to me by appellant.

Witness my hand and the seal of said District Court this 7th day of February, A, D. 1951.

EDMUND L. SMITH,
Clerk.

[Seal] By /s/ THEODORE HOCKE,
Chief Deputy.

[Endorsed]: No. 12848. United States Court of Appeals for the Ninth Circuit. The Parker Appliance Company, a Corporation, Appellant, vs. Irvin W. Masters, Inc., and Joseph C. Collins, Doing Business Under the Firm Name and Style of Collins Engineering Company, Appellee. Transcript of Record. Appeal from the United States District Court for the Southern District of California, Central Division.

Filed February 8, 1951.

/s/ PAUL P. O'BRIEN,

Clerk of the United States Court of Appeals for the Ninth Circuit.

In the United States Court of Appeals
for the Ninth Circuit

Appeal No. 12,848

THE PARKER APPLIANCE COMPANY,

Plaintiff-Appellant,

vs.

IRVIN W. MASTERS, INC.,

Defendant-Appellee.

THE PARKER APPLIANCE COMPANY,

Plaintiff-Appellant,

vs.

JOSEPH C. COLLINS, Doing Business Under the Firm Name and Style of COLLINS ENGINEERING COMPANY, Hollywood, California,

Defendant-Appellee.

STATEMENT OF POINTS FOR PLAINTIFF-APPELLANT

The points of error of the District Court which Plaintiff intends to urge on appeal from the Final Judgment of the Court in favor of Defendants in the above-entitled action are that the Court erred in:

1. Holding that United States Letters Patent No. 2,212,183, issued to Arthur L. Parker of Cleveland, Ohio, on August 20, 1940, is invalid.

2. Holding that the improvements of Parker Patent No. 2,212,183 are not defined in the patent claims.

3. Holding that the descriptive portion of Parker Patent No. 2,212,183 does not describe either the sleeve head angle or the differential angle nor illustrate the same in the drawing in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains to make construct or use the same.

4. Holding that the claims of Parker Patent No. 2,212,183 fail to particularly point out and distinctly claim the part, improvement, or combination claimed to be the discovery.

5. Holding that the recitations in each of the claims of Parker Patent No. 2,212,183 with respect to the shape of the parts fail to particularly point out and distinctly claim the part, improvement, or combination constituting the invention.

6. Failing to hold that all of the parts described in the claims of Parker Patent No. 2,212,183 coact in a combination not shown in the prior art to produce a new result.

7. Refusing to hold that the prior art listed below does not disclose the relationship of the outer surface of the sleeve head and the inner surface of the nut and fails to disclose the differential angle between the inner surface of the sleeve head and the tube flare shown and disclosed in Parker Patent No. 2,212,183:

W. N. Abbott	46,603	2/28/1865
G. H. Buzzell	177,686	5/23/1876
H. Guyer	182,435	9/19/1876
H. Guyer	196,084	10/16/1877
R. McConnell	290,446	12/18/1883
F. George	326,425	9/15/1885
I. B. Potts	406,060	7/ 2/1889
J. Anderson	535,236	3/ 5/1895
L. F. Jordan	654,735	7/31/1900
J. J. Dossert	772,136	10/11/1904
F. W. Reed	964,315	7/12/1910
S. L. Brown	1,058,542	4/ 8/1913
A. W. Bachmann	1,352,342	9/ 7/1920
J. Benzion	1,680,080	8/ 7/1928
E. E. Hewitt	1,820,020	8/25/1931

Pipes and Tubes
Their Construction and Jointing
By
Philip R. Bjorling
London
Whittaker and Co.
White Hart Street, Paternoster Square
1902
Library of Congress No. TS 280 B 6

8. Holding that Defendants have independently engaged in the business of manufacturing and/or supplying nuts, bodies, and sleeves separately but not as assembled fittings to ultimate users and failing to hold that Defendants have sold nuts, bodies and sleeves as a group in a single transaction.

9. Finding that neither the description, drawings, nor claims of Parker Patent No. 2-212,183

contain dimensions, proportions, or angular relationships corresponding to the dimensions, proportions or angular relationships contained in the government specifications under which the accused fittings and parts were made or sold.

10. Holding that no one, by reference to the Parker Patent No. 2,212,183, could produce a fitting which would achieve the results called for by the patent without experimentation.

11. Holding that the contribution of Parker Patent No. 2,212,183 to the art is extremely narrow and that the language of the claims is broad and ambiguous and broader than the invention.

12. Holding that the claims of Parker Patent No. 2,212,183 are functional at an exact point of novelty and lacking in essential structural description.

13. Holding that Plaintiff attempted to enlarge the claims of the patent in suit.

14. Failing to hold that Parker Patent No. 2,212,183 is infringed by the accused devices.

15. Holding that the differences disclosed and claimed in Parker Patent No. 2,212,183 over the prior art are merely the work of a skilled mechanic and do not involve patentable invention.

16. Failing to hold that the changes made in Parker Patent No. 2,212,183 over the prior art with respect to the relationship of the outer surface of the sleeve head and the inner surface of the nut and the differential angle between the inner surface of the sleeve head and the tube flare give rise to a

new coaction of the parts and a new combination rising to the dignity of invention and patentable.

17. Failing to hold the changes made in Parker Patent No. 2,212,183 over the prior art with respect to the relationship of the outer surface of the sleeve head and the inner surface of the nut and the differential angle between the inner surface of the sleeve head and the tube flare are properly defined in the patent claims and in a manner complying with Section 4888 R. S.

18. Holding Parker Patent No. 2,212,183 invalid because the claims therefore do not comply with Section 488 R. S. 35 U.S.C.A. 33 in accordance with the statements in Sales Affiliates, Inc. v. Hutzler Bros. Co., 71 F Supp. 287; Continental Paper Bag Co. v. Eastern Paper Bag Co., 210 U. S. 405; Yale Lock Co. v. Greenlaw, 117 U. S. 554; Incandescent Lamp Patent Case, 159 U. S. 465; Halliburton Oil Well Cementing Co. v. Walker, et al., 329 U. S. 1; and General Electric Company v. Wabash Appliance Corp., 304 U. S. 364.

LYON & LYON,

/s/ CHARLES G. LYON,
Attorneys for Plaintiff-Appellant.

Of Counsel:

BAIR, FREEMAN & MOLINARI,

/s/ WILL FREEMAN.

February 19, 1951.

[Endorsed]: Filed February 21, 1951.

[Title of Court of Appeals and Cause.]

DESIGNATION OF RECORD FOR PLAINTIFF-APPELLANT

Plaintiff, The Parker Appliance Company, designates the following portions of the record, proceedings and evidence to be contained in the record on appeal in the above-entitled cause.

The Parker Appliance Company v. Irvin W. Masters, Inc. (Civil Action No. 7874-W)

1. Original complaint filed December 29, 1947.

2. Answer and counterclaim filed February 17, 1948.

3. Reply to counterclaim filed March 16, 1948.

The Parker Appliance Company v. Joseph C. Collins, doing business under the firm name and style of Collins Engineering Company, Hollywood, California (Civil Action No. 8023-W)

4. Original complaint filed March 4, 1948.

5. Answer and Counterclaim.

Consolidated Action

6. Reply to counterclaim filed May 4, 1948.

7. Opinion of Judge Westover filed October 17, 1950.

8. Findings of Fact and Conclusions of Law, entered December 8, 1950.

9. Final Judgment entered December 8, 1950.

10. Notice of Appeal filed.

11. Statement of points upon which Plaintiff-Appellant intends to rely filed.

12. Transcript of trial proceedings before Judge Westover; including proceedings on June 14 to 16; 20 to 23; and July 5 and 6, 1950.

13. The following Plaintiff's Exhibits:

Exhibit No.	
1.	Parker Patent No. 2,212,183.
12.	Masters deposition, July 11, 1949.
12-A.	Letter from Masters to Republic Aviation Corp. dated April 27, 1949.
13.	Collins' deposition, July 12, 1949.
14.	Letter from Parker to Masters, August 12, 1943.
15.	Letter from Parker to Masters, December 3, 1943.
15-A.	Letter from Masters, Inc. to Army Air Forces, dated December 9, 1943.
16.	Letter from Parker to Masters, November 13, 1945.
25.	Parker Patent No. 1,893,442.
26.	Parker Patent No. 1,977,240.
28-A.	Stage drawing—Typical Tubing Installation.
28-B.	Stage drawing—Tubing vs. Pipe.
28-C.	Stage drawing—Tubing vs. Pipe.
28-D.	Stage drawing—Typical Fitting for lead pipe.
28-E.	Stage drawing—Wall Thickness of Flare thins out on hard tubes.
28-F.	Stage drawing—Typical Two-Piece Fitting for thin wall hard tubes.

Exhibit No.

28-G. Stage drawing—Typical Three-Piece Fitting for thin wall hard tubes.

28-H. Stage drawing—Improved Three-Piece Fitting, Parker Patent 2,212,183.

28-I. Stage drawing—Sleeve Head Angle, Parker Patent 2,212,183.

28-J. Stage drawing—Advantages of sleeve head angle. Permits free expansion of sleeve head.

28-K. Stage drawing—Advantages of sleeve head angle. Expansion of sleeve head provides hoop tension.

28-L. Stage drawing—Advantages of sleeve head angle. Hoop tension lock nut against loosening.

28-M. Stage drawing—Advantages of sleeve head angle. Free expansion corrects out-of-round sleeves.

28-N. Stage drawing—Advantages of sleeve head angle. Expansion converts toe contact to area contact.

28-O. Stage drawing—Advantages of sleeve head angle. Expansion makes amount of nut turning less critical.

28-P. Stage drawing—Advantages of sleeve head angle. Angle provides more room for expansion where expansion is greatest.

28-Q. Stage drawing—Advantages of sleeve head angle. Angle permits maximum shoulder contact.

Exhibit No.

28-R. Stage drawing—Advantages of sleeve head angle. Angle facilitates disassembly of sleeve from nut.

28-S. Stage drawing—Advantages of sleeve head angle. Angle provides additional clearance to avoid locking of sleeve to nut.

28-T. Stage drawing—Advantages of sleeve head angle. Angle prevents scoring of flare.

28-U. Stage drawing—Advantages of sleeve head angle. Angle prevents twisting of tube.

28-V. Stage drawing—Advantage of sleeve head angle. Angle facilitates disassembly of bent tubes.

28-W. Stage drawing—Advantages of sleeve head angle. Angle facilitates disassembly of damaged and tagged tubes.

28-X. Stage drawing—Differential angle Parker Patent 2,212,183.

28-Y. Stage drawing—Advantages of differential angle. Toe contact facilitates formation of holding nub.

28-Z. Stage drawing—Advantages of differential angle. Toe contact tends to produce line type seal.

28-AA. Stage drawing—Advantages of differential angle. Toe contact resists vibration failure.

Exhibit No.

28-BB. Stage drawing—Advantages of differential angle. Toe contact compensates for misaligned flares.

28-CC. Stage drawing—Advantages of differential angle. Toe contact avoids weakening of the flare at its base.

28-DD. Stage drawing—Advantages of differential angle. Toe contact facilitates expansion of sleeve head.

28-EE. Stage drawing—Advantages of differential angle. Toe contact increases wrench torque range.

47. Black and white drawing of tube and coupling.

48. Black and white drawing of tube and coupling with hand written markings.

49. Photostat having to do with zones A, B, C.

50. Chart of Claim 1 and photo of patent drawing (2,212,183).

51. Photostat of patent drawings and Claim 2, (2,212,183).

52. Photostat of patent drawings and Claim 3, (2,212,183).

53. Photostat of drawing of Masters Fitting and Claim 1 (2,212,183).

54. Invoice of Masters.

55. Invoice of Masters.

56. Photostat (Masters' Deposition fittings, Measurement of parts).

Exhibit No.

57. Photostat (Collins Deposition fittings, Measurements of parts).
58. Photostat of Masters fittings and Claim 2, (2,212,183).
59. Photostat of Collins fitting and Claim 2, (2,212,183).
62. Charts, indicating measurements.
62-A. Charts, indicating measurements.
70. Drawing referred to in Amon Deposition.
72. Document entitled "Aircraft Report."
73. Letter from Parker to Asst. Chief, Materiel Div., Wright Field, on Flared tube couplings, dated March 3, 1941.
73-A. Letter from War Dept. Air Corps. to Parker, May 25, 1942.
73-B. Letter from Parker to Commanding General, Army Air Forces, dated June 18, 1942.
77. Final judgment by Parker against V. L. Graf.
78. Photograph of No. 22695, Fig. 3 (from Douglas Aircraft Report).

14. The following Plaintiff's Exhibits to be treated as physical exhibits and not included as part of the printed record:

2. Catalog 1 of Masters, "AN Pipe, Tube & Hose Fittings" for the Aircraft industry.
3. Stock list of Collins Engineering Co.
4. Stock list, page 7, taken from Collins Engineering Company catalog.

Exhibit No.

5.	Masters No. 8 Aluminum Fitting, assembled.
6.	Masters No. 4 Aluminum Fitting, unassembled.
7.	Masters No. 4 Aluminum Fitting, cut away.
8.	Masters No. 8 Aluminum Fitting, cut away.
9.	Collins No. 4 Steel Fitting.
10.	Collins No. 4 Steel Fitting, cut away.
11.	Collins No. 8 steel fitting with copper silicon sleeve.
17.	Collins active prints, furnished by Collins at deposition of July 12, 1949.
18.	Group of blueprints furnished to Parker by Masters.
19.	NAF Fitting, assembled.
20.	NAF Fitting, cut away.
21.	Parker No. 8 brass 810 Fitting, assembled.
22.	Parker No. 8 brass 810 Fitting, cut away.
23.	Parker No. 6, 811 (prior to 1940) Fitting, assembled.
24.	Parker No. 6, 811 (prior to 1940) Fitting, cut away.
27.	Specimen of flared tube.
29.	Mock up installation of pipe.
30.	Tubing assembly.
31.	Piece of lead pipe.
32.	Parker No. 24 Aluminum Fitting, assembled.

Exhibit No.

33. Parker No. 24 Aluminum Fitting, cut away, pinned.
34. Parker No. 24 Aluminum Fitting, cut away, plastic fill.
35. Parker No. 24 Steel Fitting, assembled.
36. Parker No. 24 Steel Fitting, cut away, plastic fill.
37. Parker No. 4 Aluminum Fitting, assembled.
38. Parker No. 4 Aluminum Fitting, cut away, plastic fill.
39. Parker No. 4 Steel Fitting, assembled.
40. Parker No. 4 Steel Fitting, cut away, plastic fill.
41. Parker No. 4 Steel Fitting, cut away, embedded in plastic.
42. Parker No. 4 Aluminum Fitting, cut away, embedded in plastic.
43. Parker No. 8 Aluminum Fitting, assembled.
44. Parker No. 8 Aluminum Fitting, cut away, plastic fill.
45. Parker No. 8 Steel Fitting, assembled.
46. Parker No. 8 Steel Fitting, cut away, plastic fill.
60. Parker No. 16 Aluminum Fitting with lead pipe.
61. Parker No. 12 Aluminum Fitting with lead pipe.

Exhibit No.

63. Bjorling Fitting, uncut (per dwg. SK-3-1750-2MS).

64. Parker No. 8 Aluminum Fitting, cut away (Amon's deposition Exhibit No. 1).

65. Letter from Parker to Asst. Chief, Materiels Div. Wright Field, dated October 25, 1940.

66. Drawings referred to in Amon deposition.

67. AN-F-366 Pamphlet.

68. AN-F-47 Pamphlet.

69. Parker No. 4 Steel Fitting, cut away.

71. Parker No. 5 Aluminum Fitting, cut away, embedded in plastic.

74. License agreement from Parker to Weatherhead Company.

75. License agreement from Parker to The Deutsch Company.

76. Photostat of agreement between Parker and Pacific Screw, dated October 16, 1947.

79. No. 6 Steel Fitting.

80. No. 6 Aluminum Fitting.

15. The following Defendants' Exhibits as follows:

QQ. Deposition of C. H. Wagner, Jr., May 6, 1949.

TT. Book of prior art patents relied on by Defendants.

UU. Photograph—Douglas No. 22697.

16. The following Defendants' Exhibits to be treated as physical exhibits and not included as part of the printed record:

A.	Sketch by Wolfram of 3-pc. fitting.
B.	Sketch by Wolfram.
C.	Sketch by Wolfram.
D.	Sheet of paper marked "Fig. 86".
E.	Sketch of Wolfram, Fig. 9
F.	Parker bulletin.
G.	Parker bulletin.
H.	Drawing AND10061
H-1.	Drawing AN818.
H-2.	Drawing AN819.
H-3.	Drawing AND10056.
H-4.	Drawing AN817.
H-5.	Drawing AND10064.
I.	Parker drawing 811T.
J.	Parker drawing 811BT.
K.	Parker drawing 811FT.
L.	Parker drawing 2-1835.
M.	Parker drawing 2-1835-1.
N.	Parker drawing 2-1835-2.
O.	Drawing, Section No. 1.
P.	Drawing, Section No. 2.
Q.	Drawing, Section No. 3.
R.	Drawing, Section No. 4.
S.	Tabulation of figures representing test results.
T.	Work sheet (blank).
U.	Masters physical test specimen No. 1.
V.	Masters physical test specimen No. 2.

Exhibit No.	
W.	Masters physical test specimen No. 3.
X.	Masters physical test specimen No. 4.
Y.	Masters physical test specimen No. 5.
Z.	Masters physical test specimen No. 6.
AA.	Masters physical test specimen No. 10.
BB.	Masters physical test specimen No. 11.
CC.	Masters physical test specimen No. 12.
DD.	Masters physical test specimen No. 35.
EE.	Masters physical test specimen No. 36.
FF.	Masters physical test specimen No. 1, steel.
GG.	Masters physical test specimen No. 2, steel.
HH.	Masters sketch showing set-up for testing.
II.	Colored sectional sketch, Section No. 5.
JJ.	Colored sectional sketch, Section No. 6.
KK.	Colored sectional sketch, comparative chart, Scale 20:1.
LL.	Parker drawing 9-2941-9.
MM.	Parker drawing 1-2537-15.
NN.	Parker drawing 4-2342-2.
OO.	Parker drawing 12-2741-27.
PP.	Parker price list No. 202-C.
RR.	Certified copy of file wrapper Parker Patent 2,212,183.
SS.	Stipulation for use of soft copies and Bjorling publication.
VV.	Drawing on section paper.
WW.	Adams sample No. 4. size 8 AN Aluminum Fitting with lead pipe—30 in. lb. torque, assembled.

Exhibit No.

XX.	Adams sample No. 3, size 8 AN Aluminum Fitting with lead pipe—40 in. lb. torque, assembled.
YY.	Adams sample No. 6, size 8 AN Aluminum Fitting with lead pipe—40 in. lb. torque, cut away.
ZZ.	Adams sample No. 2, size 8 AN Aluminum Fitting with lead pipe—120 in. lb. torque, cut away.
AAA.	Adams sample No. 8, size 8 AN Aluminum Fitting with aluminum tube—200 in. lb. torque, cut away.
BBB.	Adams sample No. 9, size 8 AN Aluminum Fitting with aluminum tube—525 in. lb. torque, cut away.
CCC.	Parker Patent No. 2,191,582.
DDD.	Parker Patent No. 2,251,715.
EEE.	Parker Patent No. 2,278,479.
FFF.	Parker Patent No. 2,289,382.
GGG.	Parker Patent No. 2,290,890.
HHH.	Parker et al Patent No. 2,316,711.
III.	Drawing No. 11-1137-2.
JJJ.	Drawing No. MS 1034.
KKK.	Drawing No. MS 1030.
LLL.	Parker Patent No. 1,619,755.
MMM.	Drawing No. 11-1137-12.
NNN.	Drawing, "Copy No. 44, Issued 11-11-37; Name Std. Triple Coupling Ft. Dim."—Drawing No. 11-1137.
OOO.	Drawing, "Size A, Drawing No. 12-1133-3, Revision M." (Engineering Department No. 6T).

17. The following depositions:

Frederick E. Amon, Jr.—May 5, 1949.

Robert Henry Davies—May 5, 1949.

W. Howard Ehmann—May 10, 1949.

William D. Clark—May 10, 1949.

Edward M. Greer—May 10, 1949.

Roland C. Bergh—May 11, 1949.

18. This designation.

Respectfully submitted,
LYON & LYON,

/s/ CHARLES G. LYON,
Attorneys for Plaintiff-Appellant.

Of Counsel:

BAIR, FREEMAN & MOLINARI,
/s/ WILL FREEMAN.

February 19, 1951.

[Endorsed]: Filed Feb. 21, 1950.

[Title of Court of Appeals and Cause.]

Appellees' Substitute Counter-Designation of Record and Order as to Physical Exhibits

Appellees, Irvin W. Masters, Inc., and Joseph C. Collins, doing business under the firm name and style of Collins Engineering Company, hereby submit their substitute counter-designation of portions of the records, proceedings and evidence to be contained in the record on appeal in the above-entitled case. This substitute counter-designation is to replace appellees' counter-designation of record heretofore filed in this Court.

By this substitute counter-designation appellees designate that the following paper exhibits be included as part of the printed record:

APPELLEES' EXHIBITS

Exhibit
No.

A—Wolfram's sketch of what patent means.

B—Wolfram's sketch of variations under patent.

C—Wolfram's sketch of variations under patent.

E—Wolfram's sketch showing variation in sketch sleeve head.

H—Drawing No. AND10061.

H-1—Drawing AN818.

H-2—Drawing AN819.

H-3—Drawing AND10056.

H-4—Drawing AN817.

H-5—Drawing AND10064.

I—Drawing 811 T Sleeve.

Exhibit
No.

J—Drawing 811 BT Sleeve.

K—Drawing 811 FT Body.

L—Parker Drawing No. 2-1835.

M—Parker Drawing No. 2-1835-1.

N—Parker Drawing No. 2-1835-2.

S—Summation Sheet Sleeve Head Expansion Tests.

RR—Certified copy of file history patent in suit No. 2,212,183.

SS—Stipulation and contents re publication "Pipes and Tubes" Philip R. Bjorling, 1902 Library of Congress No. TS 280 B6.

OOO—Size A Drawing No. 12-1133-3, Revision M. This substitute designation.

II—Colored Chart AN-6 to minimum clearance assembly from drawings. This chart is to be reproduced in the printed record in reduced size convenient for incorporation in such record, namely approximately page size, but in color as on the original.

JJ—Colored Chart assembly from Parker 1935 drawings minimum clearance condition. This chart is to be reproduced in the printed record in reduced size convenient for incorporation in such record, namely approximately page size, but in color as on the original.

KK—Colored Comparative Chart. This is to be reproduced in the printed record in reduced size convenient for incorporation in such

record, namely approximately page size, but in color as on the original.

The following paper exhibits shall be included only as physical exhibits and not be printed as part of the printed record:

Exhibit
No.

D—Figure 86 of prior art publication Bjorling.

F—Parker prints dimension sheets Nos. 1601, 1601-A and 1600.

G—Parker Tube Couplings and Associated Equipment Bulletin No. 37 of 1934, pages 40, 41, 42 and 63.

O—Colored Chart AN Size 8 Assembly.

P—Colored Chart Size 6 A1. Bronze Sleeve Assembly.

Q—Colored Chart Size 6 AC 811 Fitting Assembly.

R—Colored Chart Size 6 AC 811 C.S. Assembly.

T—Work Sheet Form for Tests.

HH—Sketch of Test Set-up.

LL—Parker Drawing 9-2941-9.

MM—Parker Drawing 1-2537-15.

NN—Parker Drawing 4-2342-2.

OO—Parker Drawing 12-2741-27.

PP—Parker price list No. 202-C, pages 5, 13, 14, 15, 40, 41.

QQ—Wagner Deposition.

TT1—Abbott 46,603.

TT2—Buzzell 177,686.

TT3—Guyer 182,435.

Exhibit
No.

TT4—Guyer 196,084.

TT5—McConnell 290,446.

TT6—George 326,425.

TT7—Potts 406,060.

TT8—Anderson 535,236.

TT9—Jordan 654,735.

TT10—Dossert—772,136.

TT11—Reed 964,315.

TT12—Brown 1,058,542.

TT13—Bachman 1,352,342.

TT14—Benzion 1,680,080.

TT15—Hewitt 1,820,020.

TT16—Parker 1,977,241.

UU—Photo in Adams.

VV—Chart 4 AN A1. Bronze Sleeve showing 18½° angle.

CCC—Parker 2,191,582.

DDD—Parker 2,251,751.

EEE—Parker 2,278,479.

FFF—Parker 2,289,382.

GGG—Parker 2,290,890.

HHH—Parker 2,316,711.

III—Parker Drawing No. 11-1137-2.

JJJ—Parker Drawing No. MS 1034.

KKK—Parker Drawing No. MS 1030.

LLL—Parker 1,619,755.

MMM—Parker Drawing No. 11-1137-12.

NNN—Copy No. 44, issued 11-11-37, Std. Triple Coupling FT.Dim.

Appellant's Exhibits:

Exhibit
No.

67—AN-F-366 Pamphlet.

68—AN-F-47 Pamphlet.

Dated at Los Angeles, California, this 6th day of March, 1951.

Respectfully submitted,

HUEBNER, BEEHLER,
WORREL, & HERZIG,

HERBERT A. HUEBNER, and
VERNON D. BEEHLER,

By /s/ VERNON D. BEEHLER,

ORDER AS TO PHYSICAL EXHIBITS

It Is Hereby Ordered that exhibits numbered II, JJ, and KK, being large colored charts, may be reproduced in the printed record in reduced size convenient for incorporation in such record, namely, approximately page size, but in color as on the original.

It Is Further Ordered that the following exhibits be considered as original exhibits before the Court and need not be printed in the record: D, F, G, O, P, Q, R, T, HH, LL, MM, NN, OO, PP, QQ, TT1, TT2, TT3, TT4, TT5, TT6, TT7, TT8, TT9, TT10, TT11, TT12, TT13, TT14, TT15, TT16, UU, VV, CCC, DDD, EEE, FFF, GGG, HHH, III, JJJ, KKK, LLL, MMM, NNN, and appellant's exhibits 67 and 68.

Dated: March 7, 1951.

/s/ WILLIAM DENMAN,

/s/ WM. E. ORR,

/s/ WALTER L. POPE,

Judges U. S. Court of Appeals for the Ninth Circuit.

[Endorsed]: Filed March 13, 1951.